This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

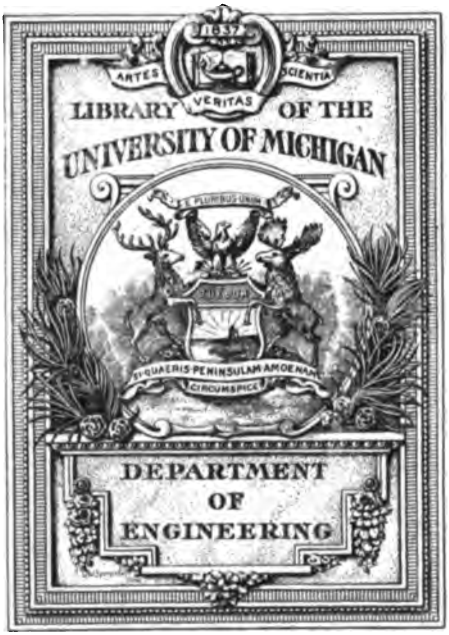
B 815,129

1837
ARTES VERITAS SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
E PLURIBUS UNUM
TUEBOR
SI QUAERIS PENINSULAM AMOENAM
CIRCUMSPICE
DEPARTMENT
OF
ENGINEERING

THE GIFT OF
Mr. J. M. Spaulding

Transferred to
GENERAL LIBRARY

GEN. LIBRARY
UF
1
C6



1837
ARTES VERITAS SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
E PLURIBUS UNUM
TUEBOR
SI QUAERIS PENINSULAM AMOENAM
CIRCUMSPICE
DEPARTMENT
OF
ENGINEERING

THE GIFT OF

Mr. J. M. Spaulding.

Transferred to
GENERAL LIBRARY

GEN. LIBRARY
UF
1
C6

Eng bd 623.5 J86 U58

JOURNAL OF THE UNITED STATES ARTILLERY

PUBLISHED UNDER SUPERVISION OF THE SCHOOL BOARD
OF THE COAST ARTILLERY SCHOOL

VOLUME 38
1912

FORT MONROE, VIRGINIA
COAST ARTILLERY SCHOOL PRESS
1912

COPYRIGHT.

JOURNAL OF THE UNITED STATES ARTILLERY

1912

CONTENTS BY NUMBERS

No. 1

H. M. S. LION.. (*Frontispiece*)

BATTLE TACTICS AND BATTLE ORDERS...................... 1
By Major WILMOT E. ELLIS, Coast Artillery Corps

A DEVICE FOR COMPUTING ELEVATIONS FOR MORTARS..... 14
By 1st Lieutenant JOHN H. PIRIE, Coast Artillery Corps

A QUIZ IN THE REGULATIONS FOR THE INSTRUCTION AND TARGET PRACTICE OF COAST ARTILLERY TROOPS.. 22
By Captain WILLIAM H. MONROE, Coast Artillery Corps

COAST DEFENSE IN THE CIVIL WAR. HATTERAS INLET, N. C. 35
By 1st Lieutenants JOHN. L. HOLCOMBE and WALTER J. BUTTGENBACH, Coast Artillery Corps

REPORT OF SUBMARINE MINE CABLE TESTING AND REPAIRS 42
By Major JACOB C. JOHNSON, Coast Artillery Corps

PROFESSIONAL NOTES:

Fort Wood, New York Harbor (Illustrations)........................ 55, 56
- Governor's Island, New York Harbor (Illustration)............ 57
- Ellis Island, New York Harbor (Illustration).................. 58
- Submarine Mine Defense of Coast Fortresses................. 59
- British Mine Layer Seaflower (Illustration).................. 68
- British Mine Layer Iphigenia (Illustration).................. 68
- Electric-Contact Mines (British), (Illustration)............... 69
- Automatic Submarine Mines.................................. 70
- The Goerz Periscope for Torpedo-Batteries and Submarine Mines 86
- The Jubilee of the Turret Ship............................. 86
- Latest British Submarine (Illustration)...................... 93
- U. S. Submarines E-1 and E-2 (Illustration)................. 94
- Our First Diesel-Engine Submarines......................... 94
- The Battleships of the New "Kaiser" Class.................. 95
- H. M. Australian Cruiser Melbourne......................... 100
- The Davis Gun-Torpedo..................................... 102
- The Rapidity of Fire of Naval Guns......................... 107
- Testing Aeroplanes.. 109
- A New Safety Explosive.................................... 109
- The Land-Side Defense of Defended Ports.................. 111

SHORT NOTES:... 115
H. M. S. Lion—New Super-Dreadnought—A Mine-Laying Squadron—Krupp New 15-Inch Gun—A New Gun—Fortifications for Canal—Continuously Loaded Telephone Cable.

NOTICES:... 117
Bureau of Mines' Publications for Free Distribution—Military Inventions.

BOOK REVIEWS: 12
All the World's Aircraft—Applied Minor Tactics—Electrical Injuries, Their Causation, Prevention and Treatment—"Tin Soldiers". The Organized Militia and What It Really Is—Field Service.

SUPPLEMENT

Index to Current Military Literature

No. 2

EVOLUTION OF THE PROJECTILE IN EXTERIOR FORM....(*Frontispiece*
FOREWORD 12
By The Editor
THE JOURNAL OF THE U. S. ARTILLERY........................ 12
By Colonel John W. Ruckman, Coast Artillery Corps
THE JOURNAL FROM SEPTEMBER, 1895, TO MARCH, 1902..... 13
By Colonel John P. Wisser, Coast Artillery Corps
TWENTY YEARS PROGRESS IN POWDERS, PROJECTILES, FUZES AND PRIMERS.............................. 14
By Captain Wilford J. Hawkins, (C. A. C.), Ord. Dept.
THE PRESENT-DAY TACTICS OF COAST ARTILLERY......... 16
By Colonel Garland N. Whistler, U. S. Army (Retired)
COAST DEFENSE EXERCISES AS HELD IN THE ARTILLERY DISTRICT OF CHESAPEAKE BAY DURING THE WAR CONDITION PERIOD, AUGUST 7-10, 1912............... 17
By Captain Harry C. Barnes, Coast Artillery Corps
COAST DEFENSE IN THE CIVIL WAR. THE PORT ROYAL EXPEDITION.. 19
By First Lieutenants John L. Holcombe and Walter J. Buttgenbach, Coast Artillery Corps
THE EXIT OF A PROJECTILE FROM A MORTAR............... 21
PROFESSIONAL NOTES:
Airplanes in Coast Warfare.............................. 21
The Lewis Aeroplane Gun................................ 22
Sighting Apparatus for Aerial Craft...................... 22
Aeronautics. An Interesting Invention..................... 22
Some Considerations which Affect the Training of the R. G. A. in Coast Defense.............................. 22
Automatic Submarine Mines.............................. 23
The Attack of a Coast Fortress........................... 24
SHORT NOTES:.. 244
Zeppelin Military Airships—French Gunpowder—Experiments with Explosives—Triple-Gun Turret Test—New Battleship Designs—The Battleship Pennsylvania—The Four-Gun Turret—Victory of Secondary Armament Advocates—The 6-Inch Gun as a Secondary Weapon—Fortification of the Panama Canal—The Relation of the Horsepower to the Kilowatt—Guiding Torpedoes from Aircraft—Universal Shell.

NOTICES: 251
Military Inventions.

BOOK REVIEWS: 256
Archives Militaires—Nautical Phraseology in English, French, Spanish and German—Historical Papers on Modern Explosives—Stories of Some Shoots or the Chronicles of a Gratified Gunner.

SUPPLEMENT

Index to Current Military Literature

No. 3

15-INCH S. B. GUN AND 14-INCH B. L. RIFLE (*Frontispiece*)

ARMOR AND SHIPS. A BRIEF RESUME OF TWENTY YEARS' PROGRESS AND ITS EFFECT ON COAST DEFENSE 259
By Captain JOHN W. GULICK, Coast Artillery Corps

ADVANCE IN COAST ARTILLERY GUNS AND CARRIAGES FROM 1892 TO 1912 278
By Major JAMES M. WILLIAMS, Coast Artillery Corps

A SCHEME FOR THE TRAINING OF A COMPANY OF COAST ARTILLERY FOR FIELD WORK IN CONNECTION WITH THE LAND DEFENSE OF SEA COAST FORTIFICATIONS 302
By Captain JOHN G. WORKIZER, Coast Artillery Corps

NOTES ON INTERIOR BALLISTICS 309
By Colonel JAMES M. INGALLS, U. S. Army (Retired)

COAST DEFENSE IN THE CIVIL WAR. PENSACOLA HARBOR, FLORIDA 312
By 1st Lieutenants JOHN L. HOLCOMBE and WALTER J. BUTTGENBACH, Coast Artillery Corps

MEDICAL SERVICE IN THE FIELD 318
By Major FREDERICK P. REYNOLDS, Medical Corps

MANUAL FOR POST AND DISTRICT ORDNANCE OFFICERS 328
By Captain MARK L. IRELAND, Coast Artillery Corps

PROFESSIONAL NOTES:
Some Military Principles which Bear on Warship Design 352
Fire Control and Identification of Ships 364
H. M. S. King George V 371
Tabulated Comparison of Big Guns in Battleships of the Navies of the World 372
The Utilization of Aeroplanes and Dirigibles for Observation of Fire of Coast Batteries and Battleships 373
Altitude of Safety for Aeroplanes 374

CONTENTS BY NUMBERS

SHORT NOTES: . . . .

The Coast Defenses of France—Three-Gun Turret in the United States—Three-Gun Turret in Italy—Three-Gun Turret in England—The German Naval Airship L.1.—American Aeroplanes—Protection from Aerial Attack—Increasing England's Coast-line Protection—The Dictagraph—14-inch Gun—Eliminating Disturbing Noises from the Telephone—French Powder—Method of Preventing Erosion—Protecting Iron and Steel from Corrosion.

NOTICES: . . . .

Military Inventions—American Association for the Advancement of Science—Bureau of Mines' Publications for Free Distribution.

CORRESPONDENCE: . . . .

The Proper Caliber for the High-Power Guns of Seacoast Batteries.

BOOK REVIEWS: . . . .

Report of the Chief Inspector of The Bureau for the Safe Transportation of Explosives and Other Dangerous Articles, February, 1912 Gunnery. An Elementary Treatise, Including a Graphical Exposition of Field Artillery Fire—Our Cavalry—Cours d' Artillerie a l'usage des eleves officiers de reserve—L. L. Poates & Co's. Complete Atlas of the World.

SUPPLEMENT

Index to Current Military Literature

INDEX TO VOLUME 38

JULY-DECEMBER, 1912

I. Authors

Barnes, H. C. Coast Defense Exercises as Held in the Artillery District of Chesapeake Bay During the War Condition Period, August 7-10, 1912 176
Buckle, C. R. Fire Control and Identification of Ships (Reprint) 364
Buttgenbach, W. J. Airplanes in Coast Warfare (Translation)... 218
Buttgenbach, W. J. Coast Defense in the Civil War. Hatteras Inlet, N. C. 35
Buttgenbach, W. J. Coast Defense in the Civil War. Pensacola Harbor, Florida 312
Buttgenbach, W. J. Coast Defense in the Civil War. The Port Royal Expedition 198
Buzzard, C. N. Some Considerations which Affect the Training of the R.G.A. in Coast Defense (Reprint) 226
Chandler, C. De F. The Lewis Aeroplane Gun (Reprint) 222
Christ, Lt. Airplanes in Coast Warfare (Reprint) 218
Coward, J. M. Stories of Some Shoots or the Chronicles of a Gratified Gunner (Review) 257
Custance, Sir R. Some Military Principles which Bear on Warship Design (Reprint) 352
Ellis, W. E. Battle Tactics and Battle Orders 1
Goliasch, Lt. The Attack of a Coast Fortress (Reprint) 240
Gulick, J. W. Armor and Ships. A Brief Resume of Twenty Years Progress and Its Effect on Coast Defense 259
Hawkins, W. J. Twenty Years Progress in Powders, Projectiles, Fuses and Primers 142
Heinrich, A. Altitude of Safety for Aeroplanes (Translation)... 374
Hislam, P. A. The Jubilee of the Turret Ship (Reprint) 86
Holcombe, J. L. Coast Defense in the Civil War. Hatteras Inlet, N. C. 35
Holcombe, J. L. Coast Defense in the Civil War. Pensacola Harbor, Florida 312
Holcombe, J. L. Coast Defense in the Civil War. The Port Royal Expedition 198
Ingalls, J. M. Notes on Interior Ballistics 309
Ireland, M. L. Manual for Post and District Ordnance Officers. 328
Johnson, J. C. Report of Submarine Mine Cable Testing and Repairs 42
McKenny, R. I. Nautical Phraseology in English, French, Spanish, and German (Review) 256
McKenny, R. I. "Tin Soldiers." The Organized Militia and What it Really Is (Review) 125

Matthews, H. T. Our Cavalry (Review)..................... 388
Monroe, W. H. A Quiz in the Regulations for the Instruction and Target Practice of Coast Artillery Troops............... 22
Neate, A. C. B. The Attack of a Coast Fortress (Reprint)...... 240
Pappalardo, V. F. The Proper Caliber for the High-Power Guns of Seacoast Batteries (Letter).................. 385
Pirie, J. H. A Device for Computing Elevations for Mortars... 14
Reynolds, F. P. Electrical Injuries. Their Causation, Prevention and Treatment (Review)......................... 125
Reynolds, F. P. Medical Service in the Field................ 318
Rhoades, A. L. All the World's Aircraft (Review)............ 124
Ruckman, J. W. The Journal of the U. S. Artillery........... 129
Skey, F. E. G. The Land-Side Defense of Defended Ports (Reprint).. 111
Smith, E. P. The Utilization of Aeroplanes and Dirigibles for Observation of Fire of Coast Batteries and Battleships (Trans. Reprint)................................. 373
Taylor, G. A. The Proper Caliber for the High-Power Guns of Seacoast Batteries (Letter)........................... 385
Totten, J. Applied Minor Tactics (Review).................. 124
Totten, J. Field Service (Review)........................... 126
Vestal, S. C. Gunnery. An Elementary Treatise, Including a Graphical Exposition of Field Artillery Fire............. 388
Whistler, G. N. The Present-Day Tactics of Coast Artillery.... 167
Williams, J. M. Advance in Coast Artillery Guns and Carriages from 1892 to 1912.................................. 278
Williams, J. M. Archives Militaires (Review) 256
Williams, J. M. Cours d'Artillerie a l'usage des eleves officiers de reserve (Review)................................ 389
Williams, J. M. L. L. Poates & Co's. Complete Atlas of the World (Review) 390
Winslow, S. S. Aeronautics. An Interesting Invention (Translation).. 225
Wisser, J. P. The Journal from September, 1895, to March, 1902 138
Wisser, J. P. Historical Papers on Modern Explosives (Review) 257
Wisser, J. P. Report of the Chief Inspector of The Bureau for the Safe Transportation of Explosives and Other Dangerous Articles (Review)............................ 387
Workizer, J. G. A Scheme for the Training of a Company of Coast Artillery for Field Work in Connection with the Land Defense of Sea Coast Fortifications.............. 302

II. Subjects

Aerial attack, protection from............................ 378
Aerial craft, sighting apparatus for........................ 223
Aerial protection of England's coastline 378
Aeroplane gun, Lewis.. 222
Aeroplanes and dirigibles for observation of fire of coast batteries and battleships.................................. 373

INDEX

Aeroplanes, altitude of safety for........................... 374
  American........................... 377
  testing of........................... 109
Aircraft, guiding torpedoes from........................... 250
Airplanes and dirigibles, sighting device for throwing bombs from 225
Airplanes in coast warfare........................... 218
Airship, L.1., German naval........................... 377
  Zeppelin military........................... 224
Altitude of safety for aeroplanes........................... 374
American Association for the Advancement of Science (Notice).. 383
Armament, secondary, victory of advocates for........................... 248
Armor and ships........................... 259
Artillery, coast, training of for field work, scheme for........................... 302
  coast, present-day tactics........................... 167
  District of Chesapeake Bay, coast defense exercises in 1912 176
  guns and carriages, coast, advance in from 1892 to 1912... 278
Attack of a coast fortress........................... 240
Automatic submarine mines........................... 232
Ballistics, interior, notes on........................... 309
Batteries, coast, and battleships, observation of fire for from aeroplanes and dirigibles........................... 373
  high-power guns for, proper caliber of........................... 385
Battle orders, and battle tactics........................... 1
Battleship design, new........................... 246
Battleships, big guns in, navies of the world, comparison of...... 372
  observation of fire from aeroplanes and dirigibles........ 373
  of the new Kaiser class........................... 95
Battle tactics and battle orders........................... 1
Bombs, sighting device for throwing of from airplanes.......... 225
Buffington's counterpoise gun carriage, ill........................... 292
Bureau of Mines' publications for free distribution (Notice)...... 117, 384
Cable, telephone, continuously loaded........................... 117
  testing and repairs, submarine mine........................... 42
Caliber, proper, for high-power guns of seacoast batteries....... 385
Carriage, Buffington's counterpoise gun, ill........................... 292
Carriages and guns, coast artillery, advance in from 1892 to 1912. 278
Chesapeake Bay, Artillery District of, coast defense exercises in '12 176
Civil war, coast defense in. Hatteras Inlet, N. C.............. 35
  Pensacola Harbor, Florida........................... 312
  Port Royal Expedition........................... 198
Coast artillery guns and carriages, advance in from 1892 to 1912. 278
Coast artillery, tactics, present-day........................... 167
  training of for field work........................... 302
  troops, instruction and target practice, regulations for, quiz in........................... 22
Coast defense exercises, Artillery District of Chesapeake Bay, 1912........................... 176
Coast defense, effect of naval development on................ 273
  in the Civil war. Hatteras Inlet, N. C................ 35
  in the Civil war. Pensacola Harbor, Florida............ 312
  in the Civil war. The Port Royal Expedition........... 198
  training of R.G.A. in........................... 226

INDEX

Coast defenses of France.................................. 375
Coast fortresses, attack of.................................. 240
    submarine mine defense of.................................. 59
Coast warfare, airplanes.................................. 218
Corrosion, protecting iron and steel from.................................. 380
Davis gun-torpedo.................................. 102
Defense, coast, effect of naval development on.................................. 273
    coast, in the Civil war. Hatteras Inlet, N. C.................................. 35
    coast, in the Civil war. Pensacola Harbor, Florida.................................. 312
    coast, in the Civil war. Port Royal Expedition 198
    coast, training of R.G.A.................................. 226
    exercises, coast, held in the Artillery District of Chesapeake Bay, 1912.................................. 176
    land, of seacoast fortifications, training of coast artillery for field work.................................. 302
    land-side, of defended ports.................................. 111
    submarine mine, of coast fortresses.................................. 59
Defenses, coast, of France.................................. 375
Delhi, new British superdreadnought.................................. 115
Dictagraph.................................. 378
Dirigibles and aeroplanes for observation of fire of coast batteries and battleships.................................. 373
Elevations for mortars, device for computing.................................. 14
Ellis Island, N. Y. ill.................................. 58
England's coastline protection, aerial, increasing.................................. 378
Erosion, method of preventing.................................. 379
Exercises, coast defense, as held in the Artillery District of Chesapeake Bay, 1912.................................. 176
Exit of a projectile from a mortar.................................. 213
Explosive, new, "imperialite".................................. 109
Explosives, experiments with.................................. 244
Field, medical service in the.................................. 318
15-inch gun, new, Krupp.................................. 116
15-inch S. B. gun being loaded with spherical shell, ill., opp.................................. 259
15-inch S. B. gun on barbette carriage, ill.................................. 279
Fire control and identification of ships.................................. 364
Fire of coast batteries and battleships, observation of from aeroplanes and dirigibles.................................. 373
Fortifications for Panama canal.................................. 116, 249
Fortifications, seacoast, training of coast artillery troops for field work.................................. 302
Fortresses, coast, attack of.................................. 240
    coast, submarine mine defense of.................................. 59
Fort Wood, Bedloe's Island, N. Y., ill.................................. 55, 56
Four-gun turret.................................. 247
14-inch B. L. rifle, D. C., with long nosed projectile in position for loading, ill., opp.................................. 259
14-inch B. L. Rifle on D. C., ill.................................. 299
14-inch gun, test of.................................. 379
France, coast defenses of.................................. 375
French gunpowder.................................. 244, 379
Fuzes, powders, projectiles and primers, 20 years progress in.................................. 142

INDEX

Goerz periscope for torpedo-batteries and submarine mines 86
Governor's Island, N. Y., ill. 57
Gun, aeroplane, Lewis 222
    15-inch S. B., being loaded with spherical shell, ill., opp. 259
    15-inch S. B., on barbette carriage, ill. 279
    15-inch, new, Krupp 116
    14-inch, test of 379
    14-inch B. L., on D. C., ill., opp. 259
    14-inch B. L., on D. C., ill., ... 299
    new, for Russian horse artillery 116
Gunpowder, French 244, 379
Gun power of Kaiser class battleships 95
Gun-torpedo, Davis 102
Guns and carriages, coast artillery, advance in from 1892 to 1912. 278
Guns in battleships of the navies of the world, tabulated comparison of 372
Guns, naval, rapidity of fire of 107
    of seacoast batteries, high-power, proper caliber for 385
Hatteras Inlet, N. C., coast defense in the Civil war 35
Horsepower to kilowatt, relation of 249
Identification of ships and fire control 364
Imperialite, a new explosive 109
Instruction of coast artillery troops, quiz in regulations for 22
Interior ballistics, notes on 309
Inventions, military 118, 251, 380
Iphigenia, British mine-layer, ill 68
Journal of the U. S. Artillery, 1892-1895 129
Journal of the U. S. Artillery, 1895-1902 138
Kaiser (new) class battleships 95
Kilowatt to the horsepower, relation of 249
King George V., H. M. S., ill 371
Krupp new 15-inch gun 116
Land defense of seacoast fortifications, training of coast artillery for field work for 302
Land-side defense of defended ports 111
Lewis aeroplane gun 222
Lion, H. M. S., ill, opp 1
Lion, H. M. S., changes in 115
L.1., German naval airship 377
Manual for post and district ordnance officers 328
Medical service in the field 318
Melbourne, H. M. Australian cruiser 100
Military inventions 118, 251, 380
Military principles which bear on warship design 352
Mine-layer *Iphigenia*, British, ill 68
Mine-layer *Seaflower*, British, ill 68
Mine-laying squadron, British, second-class cruisers as 115
Mines, electric-contact, British, ill 69
    submarine, automatic 70, 232
    submarine, defense of coast fortresses 59
    submarine, Goerz periscope for 86
Monitor, Ericsson's, ill 88

INDEX

Mortar, exit of a projectile from 213
Mortars, elevations for, device for computing 14
Naval guns, rapidity of fire of 107
Navies of the world, comparison of big guns in 372
Observation of fire of coast batteries and battleships, aeroplanes and dirigibles for 373
Orders, battle, and battle tactics 1
Ordnance officers, post and district, manual for 328
Panama canal, fortifications for 116, 249
Pennsylvania, battleship 246
Pensacola Harbor, Florida. Coast defense in the Civil war 312
Persicope, Goerz, for torpedo-batteries and submarine mines 86
Port Royal Expedition, coast defense in the Civil war 198
Ports, defended, land-side defense of 111
Powder, French 244, 379
Powders, projectiles and fuzes, 20 years progress in 142
Primers, fuzes, powders and projectiles, 20 years progress in 142
Prinzregent Luitpold, German battleship, ill. 97
Projectile, evolution of in exterior form, ill., opp 127
    exit of from a mortar 213
Projectiles, capped 262
    powders, fuzes and primers, 20 years progress in 142
Protection from aerial attack 378
Regulations for the instruction and target practice of coast artillery troops, quiz in 22
Rifle, 14-inch, on D. C., with long nosed projectile in position for loading, ill., opp 259
    14-inch, B. L. on D. C., ill 299
    14-inch, and carriage, test of 379
R.G.A. in coast defense, training of 226
San Marcos, U. S. S. (old *Texas*), 1892, ill., plan 269
Seacoast fortifications, training of coast artillery for field work in connection with 302
Secondary armament, advocates for, victory of 248
Seaflower, British mine-layer, ill 68
Shell, universal 250
Ships and armor 259
Sighting apparatus for aerial craft 223
Sighting device for throwing bombs from airplanes 225
6-inch gun as a secondary weapon 248
Submarine mine cable testing and repairs 42
Submarine mine defense of coast fortresses 59
Submarine mines, automatic 70, 232
    Goerz periscope for 86
Submarine *No. 74*, British, ill 93
Submarines, U. S. S. *E-1* and *E-2*, ill 94
Tactics, battle, and battle orders 1
    coast artillery, present-day 167
Target practice of coast artillery troops, quiz in regulations for 22
Telephone cable, continuously loaded 117
Telephone, eliminating disturbing noises from 379
Texas, U. S. S., 1912, ill., plan 271

Three-gun turret, in England.... 377
in Italy.... 376
in U. S.... 376
in U. S., test of.... 245
Torpedo-batteries, Goerz persicope for.... 86
Torpedo, gun, Davis.... 102
Torpedoes from aircraft, guiding of.... 250
Training of coast artillery for field work, scheme for.... 302
Turret, four-gun.... 247
three-gun, in England.... 377
three-gun, in Italy.... 376
three-gun, in U. S.... 376
three-gun, in U. S., test of.... 245
Turret ship, the jubilee of.... 86
Warship design, military principles bearing on.... 352
Warships, distribution of weights.... 361
elements of the fighting power of.... 359
identification of.... 364
Zeppelin military airships.... 244

III. Book Reviews

All the World's Aircraft.... 124
Applied Minor Tactics.... 124
Archives Militaires.... 256
Cours d' Artillerie a l'usage des eleves officiers de reserve.... 389
Electrical Injuries. Their Causation, Prevention and Treatment 125
Field Service.... 126
Gunnery. An Elementary Treatise, Including a Graphical Exposition of Field Artillery Fire.... 388
Historical Papers on Modern Explosives.... 257
L. L. Poates & Co's. Complete Atlas of the World.... 390
Nautical Phraseology in English, French, Spanish, and German.. 256
Our Cavalry.... 388
Report of Chief Inspector of The Bureau for the Safe Transportation of Explosives and Other Dangerous Articles.... 387
Stories of Some Shoots or the Chronicles of a Gratified Gunner... 257
"Tin Soldiers." The Organized Militia and What It Really Is.. 125

and left limits for each caliber of gun are indicated by radii. The arc corresponding to each gun caliber is drawn in broken lines; interpolated in the breaks are the numbers of guns that bear on the corresponding part of the field; thus: 1–1–1–1–2–2–2–3–3–4–4–4–3–3–2–2–2–1–1–1–1–. Each battle commander marks the gun fire command centers of his own battle command by pins with attached threads.

2. The center of an objective for naval attack will, in general, be the center of the various fire command centers (primary armament) of one fort. Objective centers are lettered from right to left as seen by an observer approaching the defenses from the sea.

3. Run-by raid courses are indicated by broken black lines, marked at suitable points "R" with subscript letter, or letters, showing the objective, or objectives, whose fire bears upon the part of the course lettered.

4. For a serious bombardment, the attack sector is drawn in black, and the different attack lines are indicated by the objective letter with a number subscript corresponding to the attack position.

5. General run-by courses are indicated the same as run-by raid courses except that full black lines are used.

6. An azimuth circle (minimum reading one degree) is drawn with the battle commander's station as a center, and a radius such that the circumference will lie well beyond all the arcs of fire. A scale arm is pivoted at the station center. The scale reads to 500 yards, although 100 yards can easily be estimated, if necessary.

[Note.—In order to determine the location of a possible target with reference to any fire command field of fire, or the number and caliber of guns that can be brought to bear, proceed as follows: Observe range and azimuth with the battle commander's D.P.F. Mark point on chart by the use of the arm scale. Stretch the fire command string (par. 1 above) beyond the plotted point, and to the fire command arc.]

The Fire Commander's Battle Chart

The field of fire of each battery (primary, intermediate and secondary) is described about the "fire command center." If there is more than one battery of any caliber in the fire command, each battery has a separate arc, the radii for withdrawn batteries successively decreasing 200 yards or so. Every battery arc is marked at the extremities with the name of the battery. The color scheme for arcs of primary batteries and the method of indicating for each battery the number of guns that bear are the same as for the battle commander's chart. As there can be no confusion as between primary and smaller calibers, red, blue, yellow, and green are again used for 6-inch, 5-inch, 4-inch, and 3-inch batteries in the order named.

Provisions are made similar to those described under 6 above. Unless the displacement of the fire commander's station for the fire command center is considerable, the two points may be taken as coincident.

The Battery Commander's Battle Chart

The field of fire is shown in the same conventional way, the center of all gun arcs being at the directing point.

TACTICAL PRINCIPLES GOVERNING THE DEFENSE

In order to develop a logical system of tactics, it will first be necessary to fix the functions of the several grades of commanders under *normal* conditions. The delimination of duties should conform to the following fundamental principles:

1. The higher the commander, the more he deals in strategy and the less he deals in the details of tactics.
2. Each commander should be allowed a maximum of initiative.
3. A commander should not trespass upon the functions of a junior, unless exceptional circumstances warrant the interference.

The district commander, through his service of security and information, will be kept constantly advised as to the movements of the enemy. His functions are mainly supervisory and strategical. In case of overlapping battle commands, he must decide when it becomes necessary to swing a connecting fire command from one battle command to another, and will issue the necessary orders.

The battle commander will be kept continuously informed by the district commander as to the maneuvers of the enemy. The former will maintain a close watch of the ships with a view to discovering the real nature of a threatened attack, being especially on the alert for such attacks as are particularly to be apprehended. He does not habitually exercise control of the mine defense, or of the employment of secondary or intermediate armament. He decides when fire by primary armament is to be opened, and what fire commands are to bring their primary armament into action. Consequently, each order issued by the battle commander as to target and fire will be construed as applying to primary armament only, unless the terms of the order imply otherwise. In all cases, except a general run-by, the target he normally prescribes is a group of ships, or a ship operating by itself. Whenever practicable, he will identify the target in general terms by reference to the formation and objective of attack. In a general run-by, the battle commander may regulate fire or not, as he deems expedient. In case he uses the general method just prescribed, subordinate commanders will be guided by general rules which will be referred to later. After the engagement opens, the battle commander watches its progress with telescope or field glass, promptly informing his fire commanders, whenever he notes that a ship is disabled. The battle command is the *strategical unit.*

The fire commander assigns targets to one or more batteries in the same way that the battle commander assigns a target to a fire command. Except when the fire commander deems it necessary in the case of a general run-by, he will not subdivide the target by prescribing a particular ship thereof as the target for an individual battery. He decides when his intermediate and secondary batteries are to be brought into action. He carefully watches the engagement, amplifying or reducing fire upon his target, as the progress of the action may seem to require. When a ship is observed out of action, he will inform his battle commander, and all his battery commanders. The fire command is the *defense unit.*

The mine commander normally exercises "mine commander's action." As regards gun fire, he will be guided by the rules prescribed for the fire commander. As regards mine defense, the mine commander will attack none but first class ships, unless otherwise authorized by the battle commander.

The battery commander (unless in exceptional circumstances to be noted later on) does not open fire unless authorized so do to by his fire commander. When ordered into action, the battery commander selects the most suitable ship of the assigned target, and maintains as rapid a fire as conditions will permit. When it becomes apparent that the ship is out of action, he opens fire as soon as possible upon another ship of his target,—and so on. Whenever he notes that his selected ship is out of action, he promptly reports the fact to the fire commander. The battery is the *fire unit.*

GENERAL RULES FOR FIRE CONTROL

1. The battery target selected will be one that is favorably located in the field of fire as regards range and direction, and will ordinarily be the one that is delivering the most annoying fire against the defense.

2. It should generally correspond to the type of armament. That is,—primary armament would engage first class ships; intermediate armament, second class ships; and secondary armament, third class ships. In the last stages of an action, however, light armament may be used at short range against first class ships.

3. In a run-by (raid, or general), the normal target will be the leading ship of the proper class.

4. In a bombardment, as the selected ship approaches the firing point, fire should be withheld as far as practicable with a view to firing guns so that projectiles will fall just before the ship reaches the firing point. Mortar fire should be directed upon the firing point, as it will be impracticable to direct fire upon a vessel describing a loop course.

5. Mortars will use D.P. shell for all targets and zones. Gun batteries will ordinarily use armor piercing shell beyond 6000 yards, and armor piercing shot or shell within that range.

6. Whenever "prepare for action" is ordered, each battery commander will select his target and will commence tracking, so that no time will be lost, when he is ordered to open fire.

7. In the case of primary armament, so long as a battery commander is in communication with his fire commander, or a fire commander with his battle commander, the junior will never open fire without orders from his superior.

8. Batteries of inferior armament will not, as a rule, open fire without the authority of the fire (or mine) commander. An exception is recognized in the case where a suitable target moving at high speed suddenly appears in the field of fire at night, or in thick weather in the day time. In such circumstances, fire will be opened at once, prompt report being made to the fire (or mine) commander.

9. Unless specific orders are issued as to rate of fire, a battery ordered into action will maintain as rapid a fire as the visibility of the target, ammunition supply, etc., will permit.

10. A mortar battery will normally fire pit salvos.

11. Each battery commander will promptly report to his fire commander the disabling of any gun of the battery, and the

fire commander will make similar report to his battle commander. The plotter of each tactical command makes, in each case, a suitable indication on the battle chart.

In the defense tactics herein proposed, no provision is made for systematic distribution of fire based upon the "power" of the various elements. The reasons are as follows:

In deducing measures of so-called "power," it is assumed that the target fired on will move uniformly and continuously through arbitrary "defense zones", that it will remain in the fields of fire of all the defense elements to be combined, that accuracy at target practice measures accuracy in battle, and that the effect of the fire of the defense may be estimated by a study of the naval combats of the Russo-Japanese War. Each of these assumptions is more or less indefinite and unsound, and the combination of assumptions will be still more indefinite and unsound. Nor can we obtain anything like a practical measure of power by allowing a generous "factor of safety," for we know neither where nor how to apply it.

In making *a priori* combinations of fire based upon the "power" of the various elements, it must be assumed that all of the elements will be continuously in commission, that a commander will have no difficulty in identifying a target from description or prediction, and that the volume of fire can be safely reduced while such identification is going forward. These assumptions are also arbitrary and generally unsound.

In an engagement between a fleet and the coast forts, the field of view will often be obscured by clouds of dust and smoke. The relative position of an individual ship with respect to others may vary as viewed from different parts of the defense. Many vessels will present appearances so similar as to preclude identification by description. The formations will frequently be confusing to observers ashore, especially so when, in bombarding, the ships are describing loop courses. In such circumstances, the battery commander will have all the trouble he can handle in putting his gun pointers and observers on the target that he selects, without taking up the additional task of firing upon a particular ship selected by his fire commander.

In a general run-by, a fair proportion of the elements of the defense will, in the general case, have been silenced. Although we have prescribed a general rule for this case, the smashing of the formation is a matter of such vital importance that the battle commander should, when practicable, regulate the distribution of fire himself. His orders will be based upon the amount of armament in commission of each fire command. The usual order of urgency in disabling ships is the first, second and last.

While the system of fire distribution proposed involves the sacrifice of *specific* concentration and dispersion of fire, the fire will be none the less effective. The general rules prescribed for the selection of a target by a battery commander, combined with a probable diversity of selection will ordinarily result in a mixed fire, both dispersed and concentrated.

These defense tactics preclude spotting, but as our system of fire control does not contemplate spotting for primary armament, this does not constitute a drawback. When it becomes necessary for batteries of inferior armament to spot, such batteries should be ordered successively into action.

The tactics will possess the following positive advantages:

1. Time is saved in getting into action.
2. Each battery will perform more effective work as a result of the initiative allowed the battery commander.
3. Battle orders will be simple and brief.

TRANSMISSION OF INFORMATION AND ORDERS

Battle messages are divided into two classes: Information and orders.

It is essential that each tactical commander should be kept constantly informed as to the movements of the enemy in which he may possibly be concerned, and as to all orders issued to co-ordinate commanders. Therefore, a message transmitted to a junior commander will also be transmitted at the same time to all other co-ordinate commanders of the same tactical command.

The data should be simple and brief in order to secure quick transmission by telephone; or, in case telephone communication fails, to facilitate code transmission by any of the ordinary means of visual signaling. (The code may also be used for telephone transmission, when practicable.)

All probable forms of naval attack can easily be provided for by battle orders, serially numbered.

The scheme of battle tactics proposed in this essay readily lends itself to the formulation of a simple code for transmitting both orders and information. The writer has devised such a code, but has withheld the same from publication.

A DEVICE FOR COMPUTING ELEVATIONS FOR MORTARS

By First Lieutenant JOHN H. PIRIE, Coast Artillery Corps

A device similar to the one described in this article was submitted by the writer to the Coast Artillery Board in December, 1909. The principles were the same, but in that device use was made of a worm screw with a pitch of one inch, running the whole length of the board. The degree slide moved one inch to the right or left with each revolution of the screw. A drum was attached to the handle at the end of the screw shaft and divided into 60 equal parts to give minutes of elevation. The ranges for the eight service zones and three subcaliber zones were on a drum similar to the azimuth drum on a mortar deflection board, and arranged so that the proper zone would be kept under the range pointer. Arbitrary corrections to be made directly and in yards as on the gun arm of a plotting board for guns. The Coast Artillery Board recommended that this device be not adopted for the following reasons:

> "Elevations may be read on the graduations of the experimental mortar arm recommended for use at mortar batteries so that the maximum probable error in range will be less than 15 yards. This error may occur at the inner limit of the 8th zone, which however is in the overlap of an adjacent zone where the possible error may be reduced to five yards.
>
> "If considered desirable, an experienced plotter can read the elevations between graduations of the arm so as to reduce even this error.
>
> "A comparison of the times required to read elevations from a mortar arm and from the device herein suggested is not considered important, in that data can now be supplied to mortars faster than pieces can be served.
>
> "In addition, the introduction of a separate device to perform work now done on the plotting board would tend to make the system of plotting more complex without a material increase in accuracy."

In addition to the above, the device suggested at that time would involve a change in the mortar arm of the boards now in use in order to make an arbitrary correction possible, would in itself be more or less expensive, and the arbitrary range correction would be, as now, only correct for the part of the zone in which the trial shots were fired.

The device now suggested and described in this paper can be made by the company mechanics at practically no expense, can be used with the plotting boards now in service until the new boards are issued and with no change in the permanent installation. Furthermore, use can be made of a powder chart, before trial shots have been fired, for estimating the probable corrections necessary, taking into consideration previous results with the same powder, and the temperature at the time of firing.

A means is also suggested by which an estimate of corrections necessary for all zones, can be made as a result of trial shots fired in any zone.

Arbitrary corrections are made in muzzle velocity instead of in yards and so hold good for all parts of the zone.

An outline of the board is shown in Fig. 1. A piece of some hard wood about 3 by 4 by 24 inches is slotted as shown, and the block "A" arranged to slide easily in the larger slot. On the upper end of the shaft extending through this block is the handle for turning and the graduated disc "B." This disc is divided into 60 equal parts and numbered at each five divisions from zero to sixty. On the lower end of the shaft is the gear wheel "C" with a circumference of exactly one inch. This wheel runs in the rack "D" extending along the whole length of the board so the block must move to the right or left exactly one inch with each complete revolution of the graduated disc. There is a double ended pointer "E," "F," and the pointer "G" attached to the block as shown. On the lower part of the board are marks one inch apart and numbered from left to right from 45 to 65 with the 55 in the center of the board. The zone range slides, some of which are shown, are to be placed in the smaller slot in the upper half of the board. The normal zone-range scales are made by plotting range-elevation curves, using the range table ranges for given elevations for abscissas and degrees of elevation from 45 to 65 for ordinates. The curves can be run a little beyond each end of the zone to allow for very slight arbitrary corrections. Then the zone range scale is the horizontal projection of this curve. Similar curves and scales are made for each of the zones given in the range table and for muzzle velocities slightly greater or less than the normal. These abnormal scales are to be used in case an arbitrary correction is necessary. Such a scale for the sixth zone minus 10 feet per second is shown in Fig. 1. A convenient way of getting the points on these curves is by using for abscissas the normal muzzle velocities of two zones and for ordinates the ranges, plotting these two points for a given

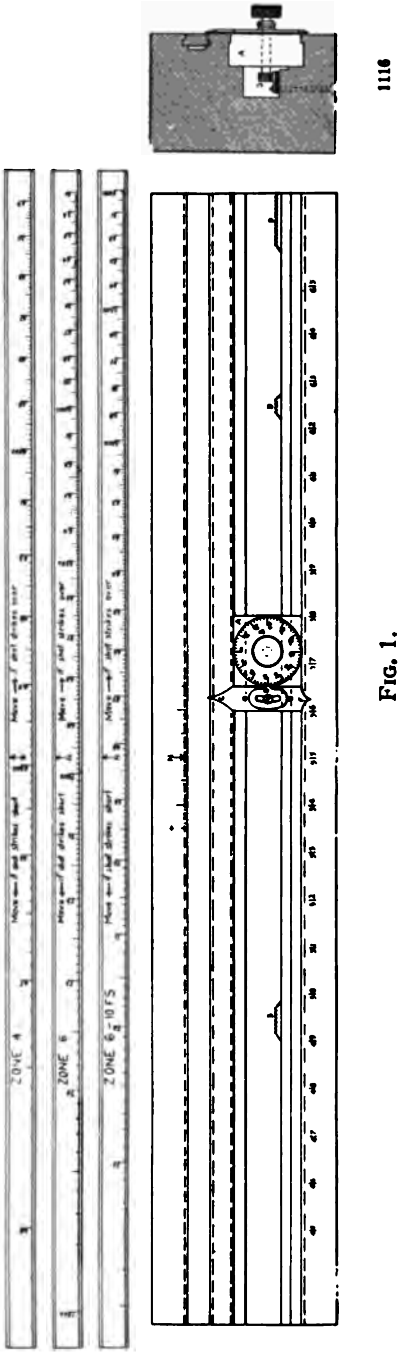

1116
ZONE 4
ZONE 6
ZONE 6-10 FS
Move ← if shell strikes short
Move → if shell strikes over

FIG. 1.

degree of elevation, on cross section paper to a scale large enough to give accuracy, connect the two points and obtain from this line the range for that degree of elevation for the desired increase or decrease in muzzle velocity. Proceed in the same way for each degree of elevation, then draw the curve and construct the scale. This, of course, is only a convenient means of interpolation for slight changes in muzzle velocity, and could as well be done by numerical calculation.

Supposing absolutely normal conditions, the use of the board would be as follows: In a plotting room where No. 4 formerly wore the head set of the telephone to the booth, a No. 6 is added and wears this head set. He also operates the elevation board. The plotter would get the predicted and set-forward points as at present, bring the mortar arm up to the set-forward point, call out the range to No. 6 and note for his own use the time of flight for his next prediction. He would then bring the arm to the predicted point, call set and let No. 1 read the azimuth for use at the Battery Commander's instrument. While the plotter is reading the range of the set-forward point, No. 1 reads its azimuth and calls it out to No. 4. No. 6 sets the pointer "E" of the elvation board at the range obtained from the plotter and calls out the elevation in degrees and minutes through the telephone to the booth. No. 4 will hear No. 6 when he calls the elevation to the booth and will then set for elevation on the deflection board, read the corrected azimuth to No. 6 who will telephone it to the booth.

Normal and corrected scales for each zone will be placed in racks about the plotting room, each rack numbered with the number of the zone and arranged to keep the normals of the scales in a vertical line. For the same degree of accuracy a greater number of scales will be necessary for the outer zones than for the inner or shorter zones. A "T" square, (Fig. 2), carrying the slide "b" is made for use on the range scale racks.

Now, as an example, suppose the trial shots were fired in the sixth zone and normal conditions were expected, the normal sixth zone scale was used in the elevation board. The target was anchored at 6850 yards from the battery, so it was found that the proper elevation was 56 degrees and 15 minutes. The center of impact of the trial shots was 150 yards short of the target or at 6700 yards from the battery. The normal sixth zone scale was placed back in the rack and the "T" square, (Fig. 2), placed so that the edge of the arm "a" read 6850 yards, the actual range of the target. It was found by running down the arm "a" that the scale for zone six — 10 feet per second, read nearest to 6700 yards, the range of the splashes. The slide "b" is brought over this scale and it was noted that the range 6700 yards was +.1 of an inch from the edge of the arm. This scale was then used in the elevation board for the record shots with its normal set at +.1 of an inch from the normal of the board.

At first glance the large number of scales necessary would seem to prohibit the use of this device but this should not be a reasonable objection if the scales are arranged in racks about the plotting room as shown in Fig. 2. With this arrangement the system should not be in the least complicated and the number of scales necessary in each zone would be left to the judgement of the Battery Commander. For instance, if in a certain zone a correction of 150 yards is the maximum expected and the Battery Commander decides that he can get sufficient accuracy with the scale in the board fifty yards from the normal then he would only need three scales in that zone, one normal, one of the proper muzzle velocity to give a correction of plus 100 yards, and one for minus 100 yards. Then if his center of impact of the trial shots were just 50 yards short of the target, he could use either the normal scale or the one for minus 100 yards and set it 50 yards from the normal. If the target were coming in it would probably be better to use the normal and if going out the corrected scale. At first the Battery Com-

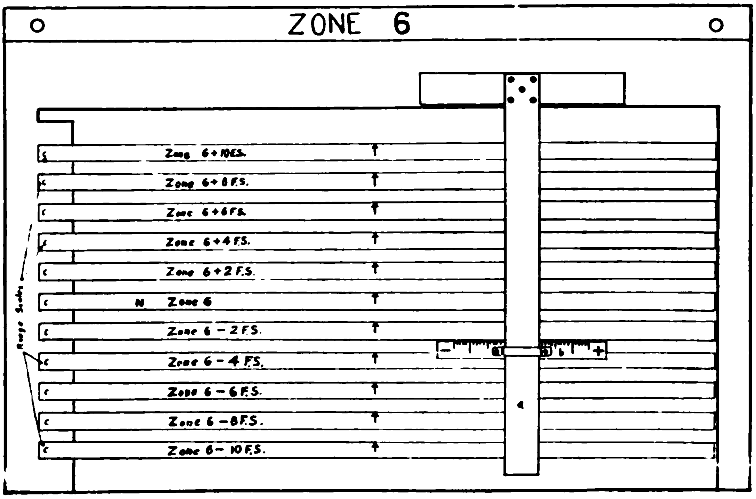


FIG. 2.

1117

mander would make up the minimum number for the zone in which he expected to have his target practice, then when he has the available time he would make scales for the other zones and for the spaces in this zone.

If the temperature is not at normal or if there are records of previous firings with the same powder, the trial shots need not be fired expecting normal conditions, but the scale for the muzzle velocity to be expected may be used. For this purpose a powder chart similar to the one used for guns may be constructed using for the normal of the chart, the normal velocity for the zone in which the trial shots are to be fired. The use of this chart is exactly the same as the use of the powder chart for guns.

It is assumed that if a charge of powder that should give a muzzle velocity of 915 feet per second has deteriorated or, due to a change of temperature, gives 9.15 feet per second, or one per cent., less than this normal, then a charge that should give 810 feet per second would under the same conditions give approximately 8.10 feet per second, or one per cent. less than its normal muzzle velocity. If this is true and since range corrections are made on this board in muzzle velocities instead of yards, it is possible to make an approximately correct estimate of the correction necessary in any zone as a result of trial shots fired in any other zone. To do this conveniently and quickly a chart is made as follows (Fig. 3). The principle is that of the ratio of the sides of similar triangles.

On ordinary cross section paper first let the point "0" be the origin. Let each inch in a horizontal direction be 100 feet per second in muzzle velocity. At the point "X," 810 feet per second from "0," erect the perpendicular "XC." Now on this line let each inch in a vertical direction equal 100 feet per second muzzle velocity. Plot the points on this line for the normal velocity for each zone and draw straight lines through these points to the origin "0." The line for zone five will be the normal, selected because this zone is near the center of the total field of fire for the 1046 pound projectile. In the direction "OY" let each inch equal two feet per second change, plus or minus, in muzzle velocity.

Now suppose the trial shots have been fired in the seventh zone and it has been determined that a scale for minus twelve feet per second should be used. If the target is in the seventh zone coming in and it is desired to have the proper reading ready to continue firing as it passes from the seventh to the sixth zone, proceed as follows. On the line "OY" run up to the line representing a change of twelve feet per second, then across the chart on this line to its intersection with the seventh zone line "Oa," then down from this point to the sixth zone line "Ob," then back on a horizontal line from this point to the line "OY" and read the loss in muzzle velocity from the

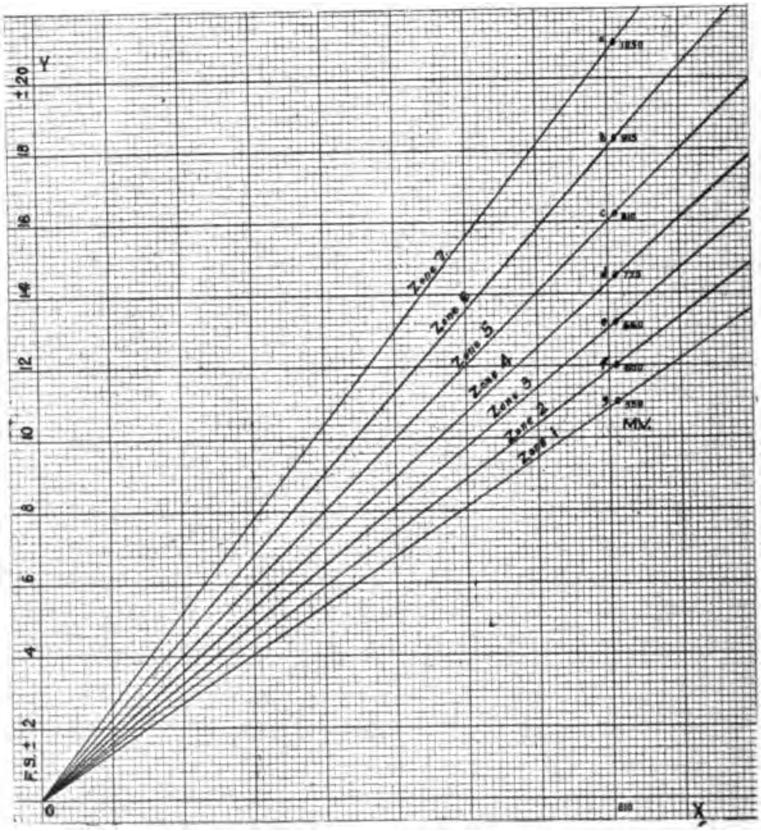


FIG. 3. 1118

normal to be expected in the sixth zone. Go to the rack for the sixth zone scales and select the one nearest to the muzzle velocity expected. In case there is no scale of exactly the velocity expected the "T" square, (Fig. 2), with its sliding scale can be used at the center of the scale selected to find the distance that it should be set from the normal of the elevation board. This, of course, is only an approximation but is an easy and quick way of working out approximate percentages of muzzle velocities and should give fairly accurate results.

A man instructed in the use of these charts and scales or the Range Officer could proceed in exactly the same way for each zone and keep the proper scales ready for use in the elevation board as the target passes from one zone to another.

This device should not only give much more accurate elevations but makes the work of the plotter much simpler since he has only to read the actual range to the target on the range scale of the mortar arm which can be brought directly over the set-forward point before reading. It should also save time and decrease the chance of serious mistakes in that there is no danger of moving a scale in the wrong direction for arbitrary corrections, no danger of mistaking the value of divisions of the degree, and no danger of reading the elevation for the adjacent zone when the set-forward point is in an overlap.

A QUIZ IN THE REGULATIONS FOR THE INSTRUCTION AND TARGET PRACTICE OF COAST ARTILLERY TROOPS

Prepared in the Department of Artillery and Land Defense,
Coast Artillery School

By Captain WILLIAM H. MONROE, Coast Artillery Corps

What orders, if any, in addition to these regulations, govern in matters of instruction and target practice of coast artillery troops?

INSTRUCTION OF COAST ARTILLERY TROOPS

1. What subjects of instruction are included in the general supervision of the department commander?

What is the new observing interval for all guns, mortars, and mines?

What is the scope of infantry instruction?

Who assigns organizations to siege artillery?

2. Define the outdoor and indoor periods.

When and how long is the indoor period?

3. What regulations govern the attendance of extra and special duty men at artillery drill?

4. Who alone is authorized to excuse anyone from coast artillery drill?

What limitations are placed on this authority?

5. What sort of an encampment is prescribed for coast artillery troops?

6. What is meant by the war condition period and when should it be chosen?

7. Who fixes the dates for coast defense exercises of the coast artillery reserves?

What regular troops go into camp with the reserves?

8. Who fixes the dates for coast artillery target practice?

When and by whom is the annual schedule for coast artillery instruction and drill made out?

9. During the indoor period, what days of the week are to be devoted to the instruction of gunners, infantry drill, parade, artillery inspection, and infantry inspection?

How often will the following exercises be held: Athletics, signaling, first aid, fire drill, recruit instruction?

What preparations will be made Friday afternoons?

What system is to be followed in arranging for coast artillery instruction during the outdoor period?

During the first month what days of the week are to be devoted to coast artillery drill, submarine mine instruction, infantry drill, parade, instruction and examination of gunners, and recruit instruction?

How often will the following exercises be held: Escort of the color, athletics, signaling, first aid, service of the piece for field guns and machine guns, fire drill, recruit instruction?

In what respects will the instruction for the second, third, fourth, and fifth months, up to the beginning of service practice, differ from that prescribed for the first month?

What is the program for the sixth month of the outdoor period?

What exercises are held during the seventh month?

In which month will small arms target practice be held?

How often will parade be held during the fifth, sixth, seventh, and eighth months of the outdoor period?

10. What is the regulation governing the attendance of district, post, fire, and mine commanders at drill and target practice?

11. What special battle command, fire command, and mine command drills will be held during the department commander's inspection?

12. What members of gun sections may be excused from attendance at battle, fire, and mine command night drills?

13. What special authority is vested in the umpires designated by the War Department for coast artillery practice?

COAST ARTILLERY TARGET PRACTICE

14. What is the object of subcaliber practice?

What records, if any, are kept?

15. What is the annual allowance of subcaliber ammunition per company assigned to the following batteries: 3-inch, 4-inch, 4.7-inch, 5-inch, 6-inch, mortars (1 company), mortars (2 companies)?

16. How may subcaliber ammunition for companies having service practice away from home stations be used?

17. What provision is made for ammunition expended in the instruction and examination of gunners?

18. How will mortar shots be distributed, when two companies are assigned?

19. What recommendation is made as to the expenditure of subcaliber ammunition during the outdoor period?

20. Name six emergency conditions under which subcaliber ammunition will be fired in the service of a gun battery?

To what will emergency conditions for mortars be limited?

21. How much time must elapse after the tracking of the target under normal conditions has been discontinued, before firing under emergency conditions may commence?

To what range finding instruments will the battery commander be limited in each emergency?

22. Describe the subcaliber targets for guns.

23. Describe the subcaliber targets for mortars.

24. Describe the subcaliber targets for battle, fire, and mine command practice.

25. What information is called for by paragraph 2, General Orders, No. 83, War Department, April 10, 1907; when and by whom is this information furnished to The Adjutant General of the Army?

26. What military exercises will be suspended for the company firing at least 48 hours prior to service target practice?

27. Who are required to attend the service practice of companies and what special report of absentees must be made?

28. What provision is made for attaching competent officers to companies for service or subcaliber target practice?

29. Who is made responsible that fire and battery commanders are familiar with the regulations governing target practice and for their efficiency?

30. How shall the district commander satisfy himself that companies comprising the battery, fire command, or battle command are ready to hold service practice?

Who shall act as fire or mine commander at posts where no field officer is stationed?

What report must be made in case this regulation is not complied with?

31. Describe in detail the method of firing mortar batteries in service practice.

32. What device will be used to fire mortars?

What is the maximum rate of fire for mortars?

33. Who is responsible for the blending of powder for service practice, verification of weights of powder charges, and records kept of the blending?

Describe the usual method of blending powder.

What is meant by compound blending and what authority must be obtained before it is resorted to?

Rule a form for powder blending; illustrate its use.

How is the actual blending of several lots of powder accomplished?

What will be the muzzle velocity and pressure for the composite charges, knowing the expected muzzle velocities and pressures of the different lots to be as follows:—

Name	Lot	Number of Charges	Pressure	Velocity
Int	22—'09	9	34,000	2,210
Du Pont	31—'08	6	36,000	2,235
Du Pont	42—'10	1	33,000	2,250

34. Except for the trial shots, at what rate should targets be towed for service practice with guns and mortars?

For guns, above 3 inches in caliber, and mortars, what two service practices will be held?

For 3-inch guns, what four service practices will be held?

35. What interval must elapse between the first and second practices of guns above 3 inches in caliber and mortars?

What interval must elapse between the practices of 3-inch guns?

36. Upon what results will companies be rated?

37. What distinction is made between the rating of fire commands and battle commands and that of companies in battery practice?

38. How many fire commands must be manned for battle command practice?

How many batteries must be manned for fire command practice?

When neither battle command nor fire command practice can be held, what will be the second battery practice of guns above 3 inches in caliber and mortars and what will be the third battery practice of 3-inch guns?

Under what general rules will this alternative practice be held?

39. Describe in detail the firing of trial shots for guns and mortars.

18. How will mortar shots be distributed, when two companies are assigned?

19. What recommendation is made as to the expenditure of subcaliber ammunition during the outdoor period?

20. Name six emergency conditions under which subcaliber ammunition will be fired in the service of a gun battery?

To what will emergency conditions for mortars be limited?

21. How much time must elapse after the tracking of the target under normal conditions has been discontinued, before firing under emergency conditions may commence?

To what range finding instruments will the battery commander be limited in each emergency?

22. Describe the subcaliber targets for guns.

23. Describe the subcaliber targets for mortars.

24. Describe the subcaliber targets for battle, fire, and mine command practice.

25. What information is called for by paragraph 2, General Orders, No. 83, War Department, April 10, 1907; when and by whom is this information furnished to The Adjutant General of the Army?

26. What military exercises will be suspended for the company firing at least 48 hours prior to service target practice?

27. Who are required to attend the service practice of companies and what special report of absentees must be made?

28. What provision is made for attaching competent officers to companies for service or subcaliber target practice?

29. Who is made responsible that fire and battery commanders are familiar with the regulations governing target practice and for their efficiency?

30. How shall the district commander satisfy himself that companies comprising the battery, fire command, or battle command are ready to hold service practice?

Who shall act as fire or mine commander at posts where no field officer is stationed?

What report must be made in case this regulation is not complied with?

31. Describe in detail the method of firing mortar batteries in service practice.

32. What device will be used to fire mortars?

What is the maximum rate of fire for mortars?

33. Who is responsible for the blending of powder for service practice, verification of weights of powder charges, and records kept of the blending?

Describe the usual method of blending powder.

What is meant by compound blending and what authority must be obtained before it is resorted to?

Rule a form for powder blending; illustrate its use.

How is the actual blending of several lots of powder accomplished?

What will be the muzzle velocity and pressure for the composite charges, knowing the expected muzzle velocities and pressures of the different lots to be as follows:—

Name	Lot	Number of Charges	Pressure	Velocity
Int	22—'09	9	34,000	2,210
Du Pont	31—'08	6	36,000	2,235
Du Pont	42—'10	1	33,000	2,250

34. Except for the trial shots, at what rate should targets be towed for service practice with guns and mortars?

For guns, above 3 inches in caliber, and mortars, what two service practices will be held?

For 3-inch guns, what four service practices will be held?

35. What interval must elapse between the first and second practices of guns above 3 inches in caliber and mortars?

What interval must elapse between the practices of 3-inch guns?

36. Upon what results will companies be rated?

37. What distinction is made between the rating of fire commands and battle commands and that of companies in battery practice?

38. How many fire commands must be manned for battle command practice?

How many batteries must be manned for fire command practice?

When neither battle command nor fire command practice can be held, what will be the second battery practice of guns above 3 inches in caliber and mortars and what will be the third battery practice of 3-inch guns?

Under what general rules will this alternative practice be held?

39. Describe in detail the firing of trial shots for guns and mortars.

18. How will mortar shots be distributed, when two companies are assigned?

19. What recommendation is made as to the expenditure of subcaliber ammunition during the outdoor period?

20. Name six emergency conditions under which subcaliber ammunition will be fired in the service of a gun battery?

To what will emergency conditions for mortars be limited?

21. How much time must elapse after the tracking of the target under normal conditions has been discontinued, before firing under emergency conditions may commence?

To what range finding instruments will the battery commander be limited in each emergency?

22. Describe the subcaliber targets for guns.

23. Describe the subcaliber targets for mortars.

24. Describe the subcaliber targets for battle, fire, and mine command practice.

25. What information is called for by paragraph 2, General Orders, No. 83, War Department, April 10, 1907; when and by whom is this information furnished to The Adjutant General of the Army?

26. What military exercises will be suspended for the company firing at least 48 hours prior to service target practice?

27. Who are required to attend the service practice of companies and what special report of absentees must be made?

28. What provision is made for attaching competent officers to companies for service or subcaliber target practice?

29. Who is made responsible that fire and battery commanders are familiar with the regulations governing target practice and for their efficiency?

30. How shall the district commander satisfy himself that companies comprising the battery, fire command, or battle command are ready to hold service practice?

Who shall act as fire or mine commander at posts where no field officer is stationed?

What report must be made in case this regulation is not complied with?

31. Describe in detail the method of firing mortar batteries in service practice.

32. What device will be used to fire mortars?

What is the maximum rate of fire for mortars?

33. Who is responsible for the blending of powder for service practice, verification of weights of powder charges, and records kept of the blending?

Describe the usual method of blending powder.

What is meant by compound blending and what authority must be obtained before it is resorted to?

Rule a form for powder blending; illustrate its use.

How is the actual blending of several lots of powder accomplished?

What will be the muzzle velocity and pressure for the composite charges, knowing the expected muzzle velocities and pressures of the different lots to be as follows:—

Name	Lot	Number of Charges	Pressure	Velocity
Int	22—'09	9	34,000	2,210
Du Pont	31—'08	6	36,000	2,235
Du Pont	42—'10	1	33,000	2,250

34. Except for the trial shots, at what rate should targets be towed for service practice with guns and mortars?

For guns, above 3 inches in caliber, and mortars, what two service practices will be held?

For 3-inch guns, what four service practices will be held?

35. What interval must elapse between the first and second practices of guns above 3 inches in caliber and mortars?

What interval must elapse between the practices of 3-inch guns?

36. Upon what results will companies be rated?

37. What distinction is made between the rating of fire commands and battle commands and that of companies in battery practice?

38. How many fire commands must be manned for battle command practice?

How many batteries must be manned for fire command practice?

When neither battle command nor fire command practice can be held, what will be the second battery practice of guns above 3 inches in caliber and mortars and what will be the third battery practice of 3-inch guns?

Under what general rules will this alternative practice be held?

39. Describe in detail the firing of trial shots for guns and mortars.

18. How will mortar shots be distributed, when two companies are assigned?

19. What recommendation is made as to the expenditure of subcaliber ammunition during the outdoor period?

20. Name six emergency conditions under which subcaliber ammunition will be fired in the service of a gun battery?

To what will emergency conditions for mortars be limited?

21. How much time must elapse after the tracking of the target under normal conditions has been discontinued, before firing under emergency conditions may commence?

To what range finding instruments will the battery commander be limited in each emergency?

22. Describe the subcaliber targets for guns.

23. Describe the subcaliber targets for mortars.

24. Describe the subcaliber targets for battle, fire, and mine command practice.

25. What information is called for by paragraph 2, General Orders, No. 83, War Department, April 10, 1907; when and by whom is this information furnished to The Adjutant General of the Army?

26. What military exercises will be suspended for the company firing at least 48 hours prior to service target practice?

27. Who are required to attend the service practice of companies and what special report of absentees must be made?

28. What provision is made for attaching competent officers to companies for service or subcaliber target practice?

29. Who is made responsible that fire and battery commanders are familiar with the regulations governing target practice and for their efficiency?

30. How shall the district commander satisfy himself that companies comprising the battery, fire command, or battle command are ready to hold service practice?

Who shall act as fire or mine commander at posts where no field officer is stationed?

What report must be made in case this regulation is not complied with?

31. Describe in detail the method of firing mortar batteries in service practice.

32. What device will be used to fire mortars?

What is the maximum rate of fire for mortars?

33. Who is responsible for the blending of powder for service practice, verification of weights of powder charges, and records kept of the blending?

Describe the usual method of blending powder.

What is meant by compound blending and what authority must be obtained before it is resorted to?

Rule a form for powder blending; illustrate its use.

How is the actual blending of several lots of powder accomplished?

What will be the muzzle velocity and pressure for the composite charges, knowing the expected muzzle velocities and pressures of the different lots to be as follows:—

Name	Lot	Number of Charges	Pressure	Velocity
Int	22—'09	9	34,000	2,210
Du Pont	31—'08	6	36,000	2,235
Du Pont	42—'10	1	33,000	2,250

34. Except for the trial shots, at what rate should targets be towed for service practice with guns and mortars?

For guns, above 3 inches in caliber, and mortars, what two service practices will be held?

For 3-inch guns, what four service practices will be held?

35. What interval must elapse between the first and second practices of guns above 3 inches in caliber and mortars?

What interval must elapse between the practices of 3-inch guns?

36. Upon what results will companies be rated?

37. What distinction is made between the rating of fire commands and battle commands and that of companies in battery practice?

38. How many fire commands must be manned for battle command practice?

How many batteries must be manned for fire command practice?

When neither battle command nor fire command practice can be held, what will be the second battery practice of guns above 3 inches in caliber and mortars and what will be the third battery practice of 3-inch guns?

Under what general rules will this alternative practice be held?

39. Describe in detail the firing of trial shots for guns and mortars.

18. How will mortar shots be distributed, when two companies are assigned?

19. What recommendation is made as to the expenditure of subcaliber ammunition during the outdoor period?

20. Name six emergency conditions under which subcaliber ammunition will be fired in the service of a gun battery?

To what will emergency conditions for mortars be limited?

21. How much time must elapse after the tracking of the target under normal conditions has been discontinued, before firing under emergency conditions may commence?

To what range finding instruments will the battery commander be limited in each emergency?

22. Describe the subcaliber targets for guns.

23. Describe the subcaliber targets for mortars.

24. Describe the subcaliber targets for battle, fire, and mine command practice.

25. What information is called for by paragraph 2, General Orders, No. 83, War Department, April 10, 1907; when and by whom is this information furnished to The Adjutant General of the Army?

26. What military exercises will be suspended for the company firing at least 48 hours prior to service target practice?

27. Who are required to attend the service practice of companies and what special report of absentees must be made?

28. What provision is made for attaching competent officers to companies for service or subcaliber target practice?

29. Who is made responsible that fire and battery commanders are familiar with the regulations governing target practice and for their efficiency?

30. How shall the district commander satisfy himself that companies comprising the battery, fire command, or battle command are ready to hold service practice?

Who shall act as fire or mine commander at posts where no field officer is stationed?

What report must be made in case this regulation is not complied with?

31. Describe in detail the method of firing mortar batteries in service practice.

32. What device will be used to fire mortars?

What is the maximum rate of fire for mortars?

33. Who is responsible for the blending of powder for service practice, verification of weights of powder charges, and records kept of the blending?

Describe the usual method of blending powder.

What is meant by compound blending and what authority must be obtained before it is resorted to?

Rule a form for powder blending; illustrate its use.

How is the actual blending of several lots of powder accomplished?

What will be the muzzle velocity and pressure for the composite charges, knowing the expected muzzle velocities and pressures of the different lots to be as follows:—

Name	Lot	Number of Charges	Pressure	Velocity
Int	22—'09	9	34,000	2,210
Du Pont	31—'08	6	36,000	2,235
Du Pont	42—'10	1	33,000	2,250

34. Except for the trial shots, at what rate should targets be towed for service practice with guns and mortars?

For guns, above 3 inches in caliber, and mortars, what two service practices will be held?

For 3-inch guns, what four service practices will be held?

35. What interval must elapse between the first and second practices of guns above 3 inches in caliber and mortars?

What interval must elapse between the practices of 3-inch guns?

36. Upon what results will companies be rated?

37. What distinction is made between the rating of fire commands and battle commands and that of companies in battery practice?

38. How many fire commands must be manned for battle command practice?

How many batteries must be manned for fire command practice?

When neither battle command nor fire command practice can be held, what will be the second battery practice of guns above 3 inches in caliber and mortars and what will be the third battery practice of 3-inch guns?

Under what general rules will this alternative practice be held?

39. Describe in detail the firing of trial shots for guns and mortars.

18. How will mortar shots be distributed, when two companies are assigned?

19. What recommendation is made as to the expenditure of subcaliber ammunition during the outdoor period?

20. Name six emergency conditions under which subcaliber ammunition will be fired in the service of a gun battery?

To what will emergency conditions for mortars be limited?

21. How much time must elapse after the tracking of the target under normal conditions has been discontinued, before firing under emergency conditions may commence?

To what range finding instruments will the battery commander be limited in each emergency?

22. Describe the subcaliber targets for guns.

23. Describe the subcaliber targets for mortars.

24. Describe the subcaliber targets for battle, fire, and mine command practice.

25. What information is called for by paragraph 2, General Orders, No. 83, War Department, April 10, 1907; when and by whom is this information furnished to The Adjutant General of the Army?

26. What military exercises will be suspended for the company firing at least 48 hours prior to service target practice?

27. Who are required to attend the service practice of companies and what special report of absentees must be made?

28. What provision is made for attaching competent officers to companies for service or subcaliber target practice?

29. Who is made responsible that fire and battery commanders are familiar with the regulations governing target practice and for their efficiency?

30. How shall the district commander satisfy himself that companies comprising the battery, fire command, or battle command are ready to hold service practice?

Who shall act as fire or mine commander at posts where no field officer is stationed?

What report must be made in case this regulation is not complied with?

31. Describe in detail the method of firing mortar batteries in service practice.

32. What device will be used to fire mortars?

What is the maximum rate of fire for mortars?

33. Who is responsible for the blending of powder for service practice, verification of weights of powder charges, and records kept of the blending?

Describe the usual method of blending powder.

What is meant by compound blending and what authority must be obtained before it is resorted to?

Rule a form for powder blending; illustrate its use.

How is the actual blending of several lots of powder accomplished?

What will be the muzzle velocity and pressure for the composite charges, knowing the expected muzzle velocities and pressures of the different lots to be as follows:—

Name	Lot	Number of Charges	Pressure	Velocity
Int	22—'09	9	34,000	2,210
Du Pont	31—'08	6	36,000	2,235
Du Pont	42—'10	1	33,000	2,250

34. Except for the trial shots, at what rate should targets be towed for service practice with guns and mortars?

For guns, above 3 inches in caliber, and mortars, what two service practices will be held?

For 3-inch guns, what four service practices will be held?

35. What interval must elapse between the first and second practices of guns above 3 inches in caliber and mortars?

What interval must elapse between the practices of 3-inch guns?

36. Upon what results will companies be rated?

37. What distinction is made between the rating of fire commands and battle commands and that of companies in battery practice?

38. How many fire commands must be manned for battle command practice?

How many batteries must be manned for fire command practice?

When neither battle command nor fire command practice can be held, what will be the second battery practice of guns above 3 inches in caliber and mortars and what will be the third battery practice of 3-inch guns?

Under what general rules will this alternative practice be held?

39. Describe in detail the firing of trial shots for guns and mortars.

In what guns only are pressure plugs used and for what shots?

40. What is the regulation governing the use of different lots of powder for the service practice of a company, including trial shots?

For what guns only will trial shots be fired and how many are allowed?

When will the trial shots be fired for guns and mortars?

41. What guns have no trial shots?

42. When may one set of trial shots suffice for two or more companies, and under whose supervision are such shots fired?

43. At what approximate ranges will trial shots be fired for 10-inch and 12-inch rifles, 8-inch rifles, 6-inch and 5-inch rifles, pedestal mount, model 1903, and 5-inch rifles, barbette balanced pillar mount, model 1896?

44. What is the ammunition allowance of record shots for each company assigned to the following batteries and how many shots will be fired at each practice: 12-inch rifles, 10-inch rifles, 8-inch rifles, 6-inch and 5-inch rifles, 4.7-inch and 4-inch rifles, 3-inch rifles?

What is the ammunition allowance of trial shots and record shots for each mortar battery practice for one or two companies assigned, and in which zones will the firing take place?

45. What assistance only is the battery commander allowed during target practice?

Who makes the calculations for the trial and record shots?

Who is responsible for the observance of all safety regulations at the battery?

46. What is the time of firing a series in battery and emergency practice and how is it determined?

47. How long before the command "Commence firing" is given should tracking begin?

48. For what reasons only will the umpire allow time out at battery practice?

What account is taken of deductions and penalties made by the umpire?

49. What must be the condition of materiel and position of personnel before beginning firing after interruption?

50. What sort of a target will be used for trial shots for guns and mortars?

51. Describe the target for record shots of guns above 3-inch.

Describe the target for record shots of 3-inch guns.

How many targets may be towed if practicable? Which is fired at first?

52. Who should be notified if the target is to be changed?

53. When one target is used in battery practice and part of it is shot away, who decides whether the practice will be discontinued until the target is repaired?

54. Who arranges for the transfer of boats from one district to another for target practice?

55. Describe the targets for record shots of mortars.

How much towline is required for mortar targets? For gun targets?

56. What measures may the battery commander take for locating the fall of shots, and when may he make an arbitrary correction based on such observations?

57. Where are the details for fire command and battle command practices worked out and what will the sealed orders for such practices contain?

When and to whom will such sealed orders be delivered by the umpire?

58. What are the conditions governing fire and battle command practice away from home station?

59. What is the time of firing a series for battle command or fire command practice and how is it determined?

60. For what reason only will the umpire allow time out during the firing of the series in battle command or fire command practice?

61. What statements should accompany copies of reports of fire command or battle command practice intended for The Adjutant General of the Army and for division headquarters?

62. What provision will be made for casualties in personnel and materiel during fire command, battle command, and emergency practice, and when will these be made effective?

63. How many and what kind of targets will be used in fire command and battle command practice?

64. Enumerate the duties of umpires.

Who alone is responsible for safety of the field of fire?

What safety precautions is the battery commander responsible for?

65. How soon must target practice reports be made out?

What provision is made for analysis and discussion of the practice?

What memorandum will be prepared by the umpire and how will it be forwarded?

66. Describe the oval course of the target for battery, fire command, battle command, and emergency practice, and state the inferior and superior ranges for the following batteries: 10-inch and 12-inch guns, guns above 3-inch and less than 10-inch, 3-inch guns.

67. Describe the method employed by the umpire in getting the target on the oval course at the proper range for the battery to commence firing.

68. In the case of mortar batteries when will the umpire direct the battery commander to open fire?

69. Who directs that the command "Cease firing" be given when it becomes unsafe to continue the fire?

70. What is the regulation governing excessive deflection error with mortars? What penalty is exacted for each interruption from such cause?

71. What assistants to the umpire will be detailed by the district commander?

What officers should not be selected for this purpose?

72. What will be their relation to the umpire during the practice?

73. What instrument will be furnished the lateral error observer on shore?

Where will he take station and what are his duties?

To whom does he submit his report?

74. To what extent do the instructions with reference to the observation of splashes in battery record and emergency practices apply to fire command and battle command practices?

75. How many observers for lateral errors are required for battery, fire command, or battle command practice?

Are lateral error observers required for 3-inch guns?

76. Who will be in charge of the towing vessel and how many assistants will he have?

How many range rakes and cameras will be required?

What splashes will be photographed?

When using the rake how are the overs and shorts determined?

To whom are the records submitted?

How will the towline be marked and measured?

77. Which has precedence, range rake or camera records?

78. What additional record should be made by the officer in charge of the towing vessel?

79. What provision is made for identifying shots in fire command and battle command practice?

80. How may the problem of identification of shots be simplified by towing several targets?

How should suggestions along this line be submitted?

81. For what purpose and how are projectile points painted for fire and battle command practice?

82. In observing the splash of trial shots from the tug, what special precautions will be taken and what methods of getting the overs and shorts will be used?

How will the overs and shorts be signaled to the battery commander?

What provision is made for plotting the splash of each trial shot and the position of both tug and target immediately before or after each shot?

83. How and by whom are the hits on the material targets determined?

When should the hits be counted?

Which shots count as hits?

Who plots the hits?

84. How and by whom are the lines of direction for each shot drawn for guns above 3 inches in caliber and mortars?

85. Describe the hypothetical target for mortars?

What shots are hits so far as deviation is concerned?

86. How and by whom are mortar hits on the hypothetical target determined?

Who certifies to the correctness of the calculations and plotting and who verifies the same?

87. What is the object of a figure of merit in battery practice with guns and who computes it?

Write and explain the figure of merit for guns, battery practice.

Write and explain the figure of merit for mortars, battery practice.

88. Write and explain the figure of merit for fire command or battle command practice.

89. State the value of the constant, C, in the above formulas for each of the following batteries: 12-inch guns, disappearing; 12-inch guns, barbette mount; 10-inch guns, disappearing; 10-inch guns, barbette; 8-inch guns; 6-inch guns, disappearing; 6-inch guns, pedestal mount and 5-inch guns; 4.7-inch and 4-inch guns; 3-inch guns, Driggs-Seabury mount; 3-inch guns, 1902 and 1903 mounts; all mortars.

90. What range is to be used in taking the probability factor, P, from the Tables on pp. 24-25 of these Regulations?

91. For the purpose of comparison in battery service practice, how are companies classified?

92. What further classification is made of the companies?

93. How are fire commands classified?

94. How are battle commands classified?

95. By whom are the relative ratings in service practice published?

96. What persons only are allowed in fire-control stations on the occasion of service practice?

97. How are ranges for rapid-fire batteries obtained?

How will the mean range to the target for record shots for use on Form 819 be determined?

98. What is the requirement of Par. 648, Coast Artillery Drill Regulations, as to the number of guns to be used?

99. What is done with the ammunition of a piece that goes out of action during the practice at a gun battery?

100. If a mortar goes out of action what is done with its ammunition?

101. What arrangement of projectiles or fixed ammunition before practice is authorized and how many trucks may be used?

102. Who gives the command "Cease firing" and what is done in case of a misfire?

103. What forms are used for target practice reports and by whom are they issued?

104. How should suggestions of battery, fire, mine, or battle commanders as to modifications in artillery materiel, methods of drill, or the regulations governing artillery practice be submitted?

105. What is done with valuable suggestions or recommendations of officers subordinate to the battery commander?

106. What is done with the photographs of splashes?

107. Who receives all the records of battery practice and makes up the report, including the necessary plotting and calculations?

Who verifies this work?

Who prepares the records of fire and battle command practice?

108. Under what circumstances only are coast artillery troops required to have service practice away from home station?

Who fixes the dates for such practice?

109. What superior officers will accompany coast artillery troops for practice away from their home stations?

Upon what footing will the visiting troops remain at the post to which they are sent for practice?

Who will supervise all matters pertaining to the practice of the visiting troops?

110. What provisions are made for the assignment of troops to batteries for practice away from their home stations?

111. In the case of a large garrison how many men may be left behind in charge of each barrack?

In this case would all the companies be ordered away at one time?

112. In the case of a one company post, how many men may be left behind?

Who is made responsible for and will care for batteries of the absent companies?

113. Will the visiting companies be permitted to use all of the regular installation and equipment at the post to which they are sent for practice?

114. Who performs all fatigue pertaining to the practice away from home station, as far as it is practicable?

115. In what condition will all necessary materiel requiring the labor of officers or enlisted men for its preparation, such as charts and range scales, be left by the visiting companies.

116. What preliminary drills and practice will be held by the visiting companies before service practice, and who is responsible that each gun and range section is sufficiently instructed before service practice takes place?

117. When must the prescribed reports of the practice away from home station be completed and mailed?

118. Do these regulations apply to companies having practice away from their home station within their own district?

119. At posts provided with a mine equipment, who instructs the mine companies?

Who gives the instruction where a detachment is detailed for this work?

120. Of what does the permanent detail assigned to the care and preservation of mine equipment consist, and what drills do they attend?

121. One month before the visit of the mine planter, how will this mine detail be increased?

From what duties are mine companies and detachments excused, when practicable, during the stay of the mine planter?

122. Where districts are supplied with boats fitted with mine-planting gear, how will these boats be used in order that

all mine companies and detachments may be thoroughly instructed?

123. What members of mine companies and detachments are required to attend instruction in mining, and who prescribes the hours for such work?

124. What is the requirement as to keeping mining casemates in service?

125. What will be the character of the drills and instructions in mine defense?

126. What elements of the defense are manned by the mine companies and detachments during night drill?

127. What arrangement will be made in order that observation firing may be practiced during both day and night drills?

128. Enumerate the duties of the commanding officer of the mine planter in the instruction work of mine planters at posts visited by them, except at Fort Monroe, Va.

129. What provision is made for an annual service mine target practice at posts provided with the necessary equipment and explosive?

130. Will unloaded mines be planted with those to be fired?

What is the requirement as to marking the positions of the loaded mines?

131. Under whose supervision will mines to be used at mine practice be assembled, loaded, tested, and planted?

What special precaution should be observed as to the selection of the time for the practice?

132. Describe the target to be used for mine practice.

133. When are the red streamers to be hoisted and when may mines be fired?

134. What is the meaning of lowering the red streamer and blowing the whistle on the tug?

135. What are the duties of the safety officer on shore?

136. When and when only may the casemate electrician turn the alternating current upon the operating board?

How should the safety officer notify the casemate that the course is clear?

What switches will then be closed?

At what command will the alternating current power be turned on the operating board and the firing switch closed?

What switch will be tripped at the command "Fire"?

137. What happens if the command "Fire" is not given at the proper time?

If the drop falls before the command "Fire" is given from the mine commander's station the mine will fire, but will it be a hit for observation firing?

If the explosion is ordered before the drop falls and the target is within 10 yards of the explosion, will it be a hit for observation firing?

138. When should the power be turned off?

139. What different precautions are taken to determine the relative position of the target and mine at the instant of the explosion?

140. Who appoints the umpire for the mine planting and practice?

How does the umpire record the score and determine the figure of merit?

141. What report does the mine commander submit?

142. In case of failure of any mine to explode, what report will be made?

143. To what extent will infantry instruction be given in garrison?

144. Describe the organization of companies into provisional battalions and regiments.

145. What period will be devoted to field training?

What subjects are comprised in the preliminary instruction of the first two weeks of this period?

What system will be followed in this instruction?

146. What will be the nature of the infantry exercises for the last two weeks of this period?

Where will the plans for the combined exercises be prepared and by whom will the umpires be chosen?

Explain how the troops of one district are, if practicable, to operate against those of another district.

How will the troops be equipped for combined exercises and marches and what provision is made for transportation of supplies?

Who are required to participate in the combined exercises?

What provision is made for conferences at the close of each exercise?

147. What instruction of noncommissioned officers is required in the form of conferences, lectures, or practical exercises during the outdoor and indoor period?

What subjects are mentioned that have to be covered?

148. What provision is made for the concealment of defenses and for the construction of the field works involved in the land defense, and what instructions will govern in regard to these matters?

What special defensive plans will be developed as far as possible during this period?

How much time will be devoted to these exercises?

149. What regulations will govern small arms target practice?

150. To what extent will instruction in signalling be given in each company?

151. What is the regulation governing athletics?

152. What instruction in first aid will be given?

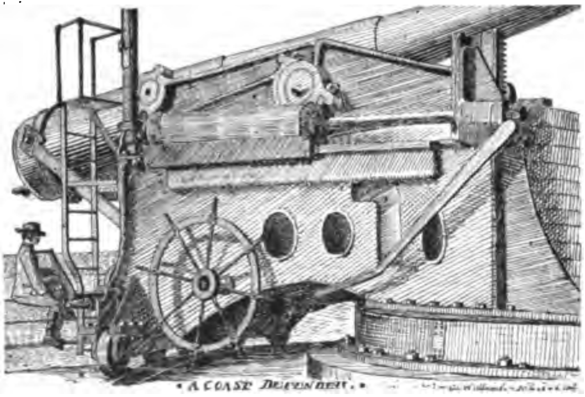
What men may be excused from this instruction?

153. What action may be taken by the department commander in the case of lack of efficiency of the personnel in any district?

What weekly reports are rendered by battery commanders during the outdoor period?

What target practice reports are rendered by battery commanders, mine and fire commanders, and battle commanders?

What reports are required from range officers, observers of lateral errors, officer in charge of range observers, time keeper, and battery officer?


A COAST DEFENDER.

COAST DEFENSE IN THE CIVIL WAR*

HATTERAS INLET, N. C.

August 28 and 29, 1861

BY FIRST LIEUTENANTS J. L. HOLCOMBE AND W. J. BUTTGENBACH,
COAST ARTILLERY CORPS

GENERAL SITUATION

Hatteras Inlet was a base for blockade runners and regarded as the key of Albemarle Sound, and next of importance to Fortress Monroe and Hampton Roads. It formed a good base for the blockading fleet and was necessary for the navy, being off a bad coast. It was intended to be strongly fortified. The forces there were expecting an attack and were improving the defenses. If in possession of federal forces, blockade running would cease from this point.

SPECIAL SITUATION

This expedition was organized at the request of the navy and was made for the purpose of acquiring a base for the blockading fleet.

OPPOSING FORCES

Works.—

Fort Hatteras was a square redoubt revetted with sod and with *pan coupe* at the salients; it had emplacements for 15 guns—10 of which were mounted, although the work was originally intended to mount 25. Some of these were rifled, but most of them were 32-pounders. There was also a bombproof for 400 men, traverses, etc. Its command was 10 feet above high water and its garrison between 600 and 700 men for both works, *i.e.* Fort Hatteras and Fort Clark. The troops were said to have been in a high state of discipline.

Fort Clark, 700 yards north of Fort Hatteras, was an irregular redoubt, with parapet 18 feet thick seaward, 5 feet on the gorge and prepared for rifle defense. It mounted five guns, 2 of them six-pounders. Its crest corresponded with the natural line of sand dunes and had a command of 10 feet.

---

* See note to "Coast Defense in the Civil War, Fort Sumter, S. C., (First Attack)," in JOURNAL U. S. ARTILLERY, for March-April, 1912.

Naval forces.—

The naval forces, under command of Commodore Stringham, had the following vessels:—

Minnesota	47 guns.
Wabash	46 guns.
Cumberland	24 guns.
Susquehanna	15 guns.
Pawnee	9 guns.
Harriet Lane	5 guns.

Also, 4 transports with troops under Major General Butler, parts of two regiments, 1 company of artillery (Regular Army), in all some 860 men.

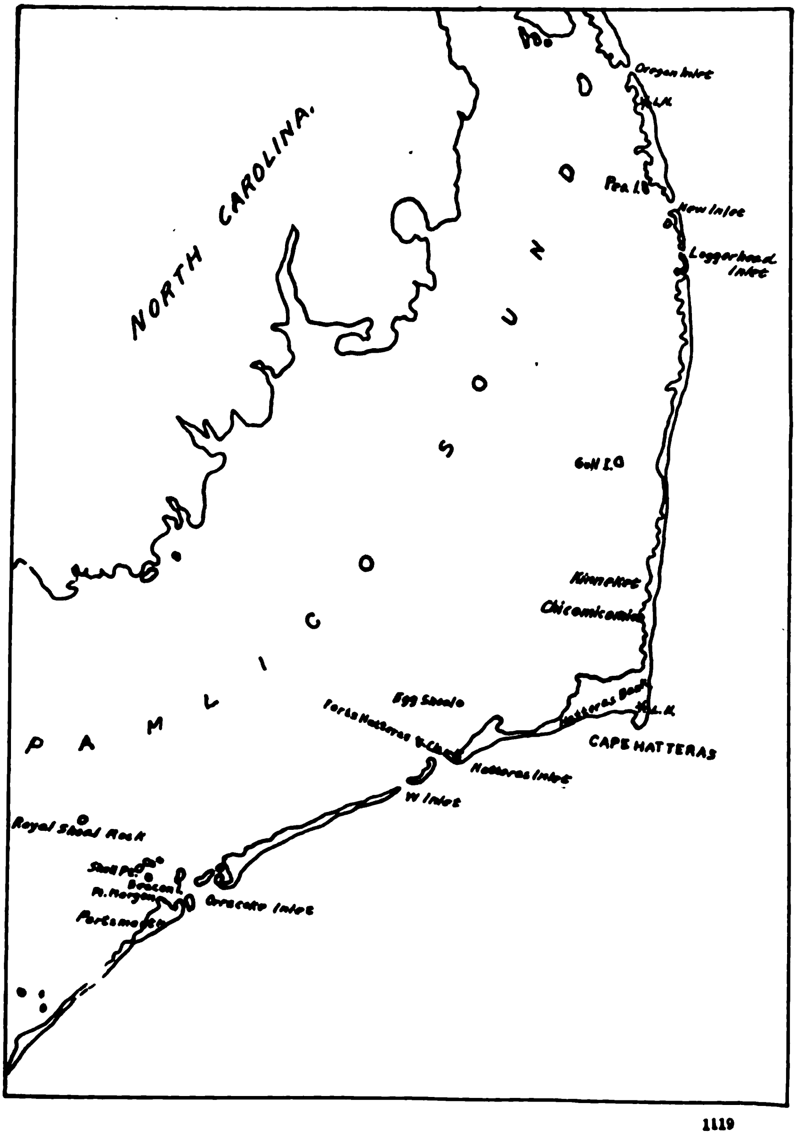
NARRATIVE OF EVENTS

The expedition was organized August 25, 1861, at the navy's request. General Orders No. 13, Headquarters Department of Virginia, directed that an expedition be made up under command of Major General Butler, U. S. Vols., consisting of 860 men, 1 company being regular artillery. This expedition was placed under command of S. H. Stringham, Flag Officer, Atlantic Blockading Squadron. The troops were provided with 10 days rations and 140 rounds of ammuntion per man. They left Fort Monroe, at 1 P.M., August 26, in 3 transports and a tug, convoyed by the fleet mentioned above. Arrived off Hatteras Inlet 4 P.M., August 27. The fleet came to anchor at 5 P.M. and preparations were made for the landing of troops for the next day. On August 28 landing was made under cover of the Pawnee, Monticello and Harriet Lane. At 6:45 A.M. signal was made to disembark troops.

These ships with the transports stood in about 2 miles east of the fort and at 11:30 A.M. began landing troops. There were southerly winds and a heavy surf. The landing had to be stopped after getting ashore 300 troops and two 12-pounder guns. The troops were volunteers, marines and a few sailors. In the operations of landing all small boats were stove in.

At 8:45 A.M., the Wabash with the Cumberland led the way towards Fort Clark, the Minnesota following. It was known that the forts could be approached to the eastward within one mile by ships drawing 20 feet.

At 10 A.M. the Wabash and Cumberland opened fire on Fort Clark. At 10:10 A.M. the Minnesota passed inside of the Wabash and Cumberland and also opened fire. These vessels


NORTH CAROLINA.
Oregon Inlet
L.H.
Pea I.
New Inlet
Loggerhead Inlet
Gull I.
Kinnakeet
Chicamicomico
Hatteras Bank
L.H.
CAPE HATTERAS
Egg Shoals
Forts Hatteras & Clark
Hatteras Inlet
W Inlet
PAMLICO SOUND
Royal Shoal Rock
Shell Pt.
Beacon I.
Ft. Morgan
Ocracoke Inlet
Portsmouth

1119

continued passing and repassing the fort, firing until it was abandoned by the enemy. The fire was returned by the fort, the shot falling short, or passing over the ships.

At 11:00 A.M., the Susquehanna was directed to engage the the batteries.

At 12:25 P.M., flags were down on both works. Fort Clark was apparently abandoned by the enemy, some of whom were running toward Fort Hatteras and some leaving the inner shore in boats. At 12:30 P.M., the fleet ceased firing and at 1:10 P.M. federal troops were moving up the beach toward the work.

At 2 P.M., the United States flag was flying over Fort Clark, being raised by a landing party who found the works abandoned. Its guns had been spiked with nails. One company was left there as a garrison.

At 4 P.M., in view of the fact that no Confederate flag was flying, the Monticello was ordered to feel her way into the inlet and take possession of the forts from the rear. She had advanced but a short distance when fire was reopened on her from Fort Hatteras. Moreover, a tug towing a schooner filled with troops was seen coming from the southward for the relief of the fort. This relief was driven off by two guns, a 12-pounder gun and a 12-pounder howitzer, that had been landed from the fleet and placed in battery east of Fort Clark. At once signal was made to "engage batteries."

It had been expected by the union naval commander that as there was no flag flying, the fort was to surrender, but the confederates had no flag to fly. Their flag had been destroyed, but the confederate commander did not know it.

The Minnesota, Susquehanna and Pawnee opened fire at once. The Monticello, due to its advanced position in the inlet, was struck several times, but was finally hauled off without serious damage. The Monticello was on the bar about 50 minutes, during which time she fired 30 rounds, besides others while entering and leaving, in all expending 90 to 100 shell and 3 shrapnel. She had 2 men wounded.

At 6:15 P.M., signal "cease firing" was made. The squadron hauled off for the night, except the Monticello, Pawnee and Harriet Lane, who were ordered in to protect the troops ashore. The other ships drew further out.

The wind was from the south, weather looking squally. On shore, one company besides the one in the fort already mentioned was left near Fort Clark. The remainder of the force bivouacked at the landing point, stationing outposts in various directions. The night passed quietly.

The next morning, the wind was south west, the weather pleasant. At 5:30 A.M., at the general signal "prepare to engage batteries," the fleet weighed anchor, stood inshore and found that the landing party was near the place where they had landed.

At 7:15 A.M., the Monticello and Pawnee were directed to attend the troops on the beach and embark them if they wished to come off; if they did not, then to send provisions ashore.

At 7:30 A.M., the fleet was directed in firing not to fire on the fort in possession of federal troops. At 8:00 A.M., fire was opened by the Susquehanna, Wabash, Minnesota and Cumberland. It was soon observed that their shots were falling short. Firing was then temporarily suspended and the fleet directed to use 15-second fuses with 10-inch guns only.

At 9:35 A.M. firing recommenced, shot falling in and around the battery with good effect. At 9:45 A.M. the Harriet Lane joined in with her rifled gun.

The navy's fire was also augmented by the two 12-pounders mentioned above as on shore and one 6-pounder that had been taken from Fort Clark and made serviceable.

At 11:10 A.M., a white flag was displayed on the fort and signal was made to cease firing.

The confederates returned the fire throughout the engagement, but with no effect, their shot falling short. The guns on the works could not be sufficiently elevated to obtain an effective range and no hits were made by them except on the Monticello which was struck 5 times by 8-inch shells, 4 hits in the hull and one through the rigging, while lying on the bar under fire from Fort Hatteras. The damage was slight. In all probability less than ten guns were firing from the work. The Wabash was struck twice by shot from a rifled cannon, damage slight. No other casualites were reported on the fleet.

On the appearance of the white flag, the federal troops marched toward the fort. At 11:30 A.M., Major General Butler, aboard the tug Fanny entered the inlet to the rear of the forts to take possession. Three steamers and several schooners with troops on board were in the Sound watching the engagement. These, however, withdrew as the Fanny commenced firing at them with her one rifled gun. The transports also then entered the inlet and further landing of federal troops was made and the fort occupied.

At 2:30 P.M., General Butler with the confederate officers came aboard the flagship, where the formal surrender was made. They and the garrison surrendered as prisoners of war. Nearly 700 prisoners were taken, 678 of whom were sent to New York. One thousand stands of arms and 25 guns also were surrendered. The losses of the confederates were said to have been 7 killed and 25 wounded, while another account says 45 were killed.

GUNNERY DATA

Ammunition expended by fleet.—

- Monticello,
  - 46, 10-inch shells,
  - 40, 32-pounders,
  - 3, shrapnel,
  - 89 rounds.
- Pawnee,
  - 50 rounds.
- Harriet Lane,
  - 22, 8-inch shells,
  - 18, 32-pounders.

The expenditures of ammunition on the other ships is not known, tho it was said by the confederates that 10 shells a minute, on the average, struck the fort and sometimes the number was as high as 20 or 28.

In Fort Hatteras 2 guns were found dismounted by fire from the ships, otherwise there was very little damage. Fort Clark was said to have been abandoned the first day as every charge and primer had been fired. It had been in action nearly an entire day. Further, it was said by the confederate commander that, owing to the position the fleet took, he could bring only three guns to bear, while the fleet brought 70 guns on the fort.

COMMENTS

1. The fleet fire smothered the fire of the forts.
2. The range of the fort guns was insufficient to reach the fleet.
3. The ammunition at Fort Clark was exhausted the first day, necessitating the abandonment of that work.
4. The forts were in an unfinished condition, as to guns mounted, although an attack was expected.
5. The dismantling of Fort Clark was not properly done. A captured gun was turned against the confederates.

6. Landing the 2 guns enabled the attacking force to beat off confederate reinforcements.

7. The fleet fire was highly efficient, the ships changing positions continually during action.

8. The damage by fire to materiel in Fort Hatteras was slight, 2 guns were dismounted.

9. The defenders should have made a night attack on the detachment of less than 400 men, who were landed the first day.

10. There was no reconnaissance on the part of the confederates to learn the plans of the federal troops, or their position on the beach.

11. The attitude of the troops behind the parapets was purely defensive.

12. There was excellent co-operation between the attacking fleet and army.

13. The surrender was apparently not justifiable. This is another example, though on a smaller scale, of a force taking shelter in a fortified work and awaiting the arrival of the enemy, with again its resultant surrender.

If the work could not be held, it could probably have been abandoned earlier in the action, or rather before the action, saving the garrison. If it had to be ultimately given up, destruction of its armament should have been thoroughly done.

14. Further, this again illustrates the danger of a work subject to an attack, finding itself short of ammunition. An ample supply of ammunition must be assured before danger is threatened.

AUTHORITIES

Official Records of the Union and Confederate Armies, Series I, Vol. 4, pp. 579-584.

Official Records of the Union and Confederate Navies, Series I, Vol. 6, pp. 119-145.

Battles and Leaders of the Civil War, Vol. I, pp. 632-635.

The Navy in the Civil War, The Atlantic Coast, pp. 163-172.

REPORT OF SUBMARINE MINE CABLE TESTING AND REPAIRS

District of San Francisco
OFFICE OF THE ARTILLERY ENGINEER
The Presidio of San Francisco, California
May 6, 1912

The following report of the methods and material used in cable testing and repairs in this Artillery District during the past two years is respectfully submitted. It is based on five months personal work in the testing room and cable tanks, and on several additional months of general supervision in cable testing and repairs. The installation and methods recommended herein for cable testing are those which have been found by actual experience to be best adapted to damp climates such as exist in this Artillery District. So far these have proven very satisfactory and by their use there has been no more difficulty in testing on rainy or foggy days than in dry weather. They have been thoroughly tried out during the past rainy season and there has never been a day of rain or fog when absolutely "clear," battery and leads could not be readily obtained.

This has been accomplished, in general, by better insulation than is prescribed by either Artillery Memorandum No. 1, War Department, 1908, or by the Provisional Manual for Submarine Mining, 1906; and, by having a thoroughly dry testing room. In detail it requires:

1. Better battery insulation.
2. Better cable lead insulation.
3. Hotter paraffin for insulating.
4. Drier testing room than usually used.

The above allows:

1. Less ground lead insulation.
2. Less instrument insulation.
3. Less delays.

For convenience, most of the work this winter was carried on at a temporary cable tank at the Presidio. There being no testing room attached, use was made of a separate building about 30 feet away for installation of battery and instruments as shown in Figures 1 and 3. This necessitated running the leads through the rain or fog for that distance as shown in those cuts. This however was no disadvantage as there was no chance for "leaks" across this space and it gave no trouble whatever.

INSULATION

Cable Lead.—The cable lead was of the best loading wire and was suspended *in the air* from testing switch to cable tank by means of marline boiled in paraffin attached to porcelain cleats or knobs, as shown in Fig. 1. Rubber insulation stripped from loading wire and thoroughly paraffined serves as a substitute for the marline, but it has more stretch and requires more watching to keep the lead from sagging against partitions where it passes through. The loading wire conductors should be removed if used for this purpose. The lead was at first run through walls and partitions by means of porcelain tubes in contact with the wood work, but owing to "leaks" thus afforded, this had to be abandoned. It was then centered through three-inch holes by means of paraffined marline as shown in Fig. 1, so that from testing switch to cable tank, "leaks" are now practically impossible. Then with one end of the lead in a dry testing room and the other end, either suspended in the air, (as when testing the leads) or together with the connector and the end of the cable conductor dipped

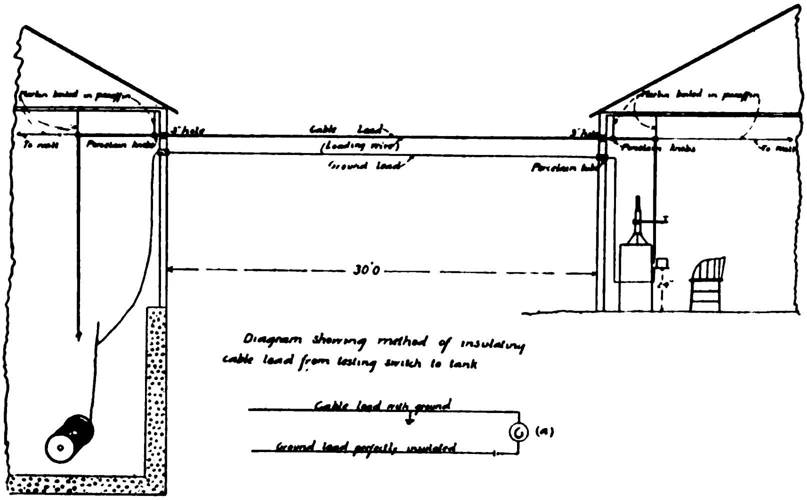
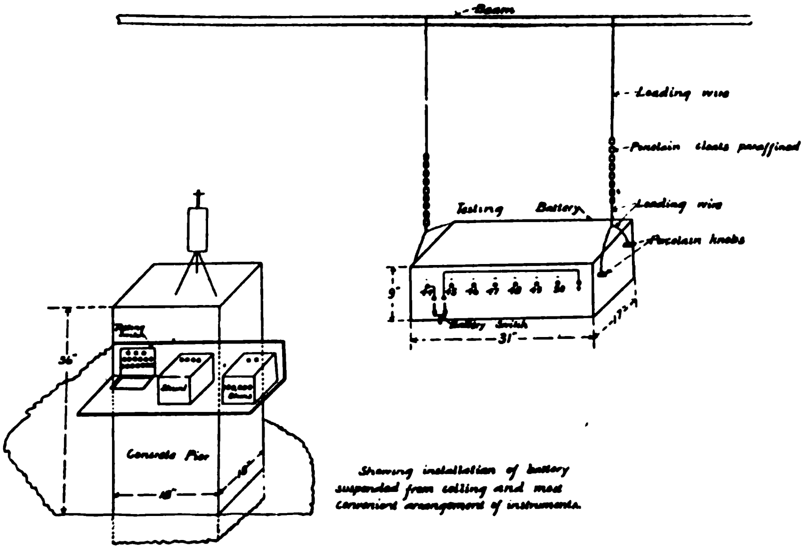

Marline boiled in paraffin
To wall
Porcelain knobs
3" hole
Cable Lead
(Loading wire)
Ground Lead
Marline boiled in paraffin
3" hole
Porcelain knobs
To wall
Porcelain tube
30'0
Diagram showing method of insulating cable lead from testing switch to tank
Cable lead with ground
Ground lead perfectly insulated
(a)

FIG. 1. 1120

in *hot* paraffin (as when testing the cable) there is practically no more chance of "leaks" in wet weather than in dry.

Ground lead.—The ground lead is not so important. Loading wire was used as heretofore but no efforts were made to insulate it and a bare wire would serve the purpose as well. Sketch (a) Fig. 1, illustrates this point. Under the provisions, of Artillery Memorandum No. 1, War Department, 1908, (par. 6, page 5), the ends of both the cable and ground leads should be suspended in the air for "insulation test of leads." The memorandum contemplates that both leads be thoroughly insulated. Sketch (a) shows such condition to exist on the ground lead but shows a "leak" on the cable lead. In can not be detected by the prescribed test. As soon as the ground lead is grounded the "leak" is shown by a deflection of the galvanometer. In practice the ground lead is left "grounded" for this test, perfect insulation of the cable lead being all that is required. It is clear then, that no use is made of insulation on the ground lead and a bare wire might be used as well. Porcelain tubes, cleats, knobs, or staples, whatever was most handy, was used for securing it to the walls. Fig. 1, shows it installed overhead simply for convenience in clearing the ground space between buildings.



Showing installation of battery suspended from ceiling and most convenient arrangement of instruments.

FIG. 2.

1121

Battery.—This was suspended from the ceiling, as shown in Fig. 2. This allows the only paths for "leaks" from the battery to be readily accessible for inspection and drying and is to be preferred to glass insulators underneath resting on a table or floor. The advantage of a *chain* of cleats is that a "leak" across one may not find its way across others and it gives less trouble than if only one or two are used.

Instruments.—The most convenient arrangement of the instruments for operation is shown in Fig. 2. (The connections are as given in the Manual.) This arrangement allows the shunt to be operated with the right hand and the testing switch with the left. The testing switch is installed vertically with an opening in the shelf beneath in order to allow the heat to circulate to the best advantage through the contacts and connections. No insulators of any kind are necessary under the instruments. The galvanometer sits on top of the concrete pier and the others on a shelf attached thereto. These instruments are all well insulated themselves and with the battery and leads installed as above, and with the testing room *thoroughly dry*, further insulation prescribed by Artillery Memorandum No. 1, War Department, 1908, is unnecessary.

ARTIFICIAL HEAT

In the temporary testing room at the Presidio there was a small coal stove. In the testing rooms at Fort Winfield Scott, and Goat Island a gasoline torch was used, the latter giving as good results as the former. On rainy days when there was so much dampness in the testing room that the galvanometer would give 30 or 40 deflections even on the "infinity" and "zero" shunts (in other words, with circuit open) an hour or two of heat from either the stove or torch with a little ventilation at the tops of windows would invariably insure zero deflection on unity shunt. In practice a helper dries out the room for a couple of hours before my arrival and usually at first trial the battery and leads test "zero" on unity shunt with not a shade of a deflection even on rainy days or in dense fogs. Cable testing is never undertaken until battery, leads, and connections test absolutely free from grounds, and by using the above method there is seldom any delay—which can not be said for the prescribed methods.

In this connection it should be noted that the present telescope on the galvanometer is very difficult to free entirely from parallax and when present, a slight movement of the head laterally gives the appearance of a point or so deflection. Parallax can however be entirely eliminated and with proper light, still give a clear reading on the scale. This, of source, is essential for accurate reading.

CABLE TESTING

Cable ends.—It has been found very important that the officer in charge of the test personally examine the conductor ends as prescribed, (page 1, Artillery Memorandum No. 1, War Department, 1908). The following irregularities have been observed:

1. Tag wires pinched through the insulation. (Tags are necessary on the old 7-conductor cable.)
2. Corresponding tags causing "grounds" by touching adjacent tags, conductor, or armor.
3. Short knife-edge armor ends cut through conductor insulation causing grounds.
4. Tape not removed from insulation at penciled end. This being generally damp conducts leaky current under the paraffin coating. In several cases remaining *threads*, only, have caused such leaks. On otherwise good insulation such leaks are generally indicated by unsteady deflection on or near unity shunt.
5. Moisture on conductor ends: Par. 1, page 6, Artillery Memorandum No. 1, War Department, 1908, prescribes that paraffin should be "just above melting point. It should not be boiling." Melting and boiling points of paraffin vary, but are generally over 120° F. and 300° F. respectively. It should be hot enough to evaporate any moisture present on the conductor ends, which requires it to be over 212° F. The thick coating prescribed has been found to be unnecessary.
6. Conductor ends not properly dipped. All should be first dipped together at each cable end for drying, then later dipped individually after being connected up for testing.

The constant.—This is taken as prescribed by Artillery Memorandum No. 1, War Department, 1908, except that the deflection is not recorded until the end of 1 min. It usually drops a division or two during this time. This is especially important in testing bad cable as then the constant drops quickly due to use of excessive current from the battery. It is important to notice whether galvanometer returns to zero.

Otherwise than above, Artillery Memorandum No. 1, War Department, 1908, and the Provisional Manual, 1906, were followed.

Copper test.—The true length of a cable should be that of its center conductor. However due to personal errors, instrumental errors, and to deterioration of conductors its computed length does not always agree with its actual length. In practice a length about 2% too great has been found by computation when compared with known lengths. This however varies with cable of different age and allowance is made accordingly by comparing computed lengths with known lengths of the several lots on hand. If the center conductor can not be relied upon the drop is taken across two or three in the inner layer, singly, in parallel, and in series for check. These conductors are longer than the center one and should give a greater percentage error. In reading the instruments it has been found advantageous to use a rheostat for regulating the current to an even ampere, then by the aid of a 3-inch ordnance reading glass the voltage is read accurately to even tenths. The reading glass is used with both ammeter and voltmeter.

CABLE REPAIRS

The following photographs taken by Master Electrician Max H. Hagenah, C. A. C., pertain to a 7-conductor cable. The methods used with 19-conductor are practically the same.

Voltmeter test.—This is taken to locate the bad conductors if a record of last test is not on hand. After first repairs it is necessary for indicating further faults.

Burning out.—The cable is first unreeled and coiled on the ground as shown in Fig. 3. In a clay soil a shallow trench about 4 feet wide and 40 or 50 feet in diameter would be advantageous for holding the cable and keeping it covered with water. Here, the soil is so sandy, the cable has to be thoroughly wet down with a hose just before burning out each time.

The A. C. power from the motor generator set in the casemate is then turned on. Fig. 4, shows a burn out at the smoky spot by the tape in center of photograph. Fig. 5* shows three lamps in parallel substituted for the 90-ohm resistance on the operating board. One of the resistance units was burned out in cable repair work and the lamps have since been used. They are recommended for this purpose to save the resistance coils.

Bird-caging armor.—Fig. 6, shows the clamps in position 17 inches apart with the *burn out* half way between as marked with the tape.

---

* Not reproduced.

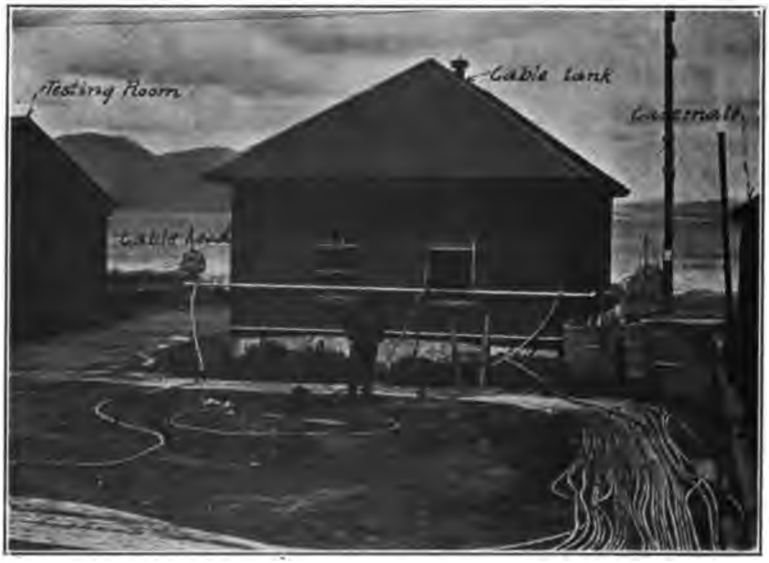


Fig. 3. 1122

Cable ready for repairs

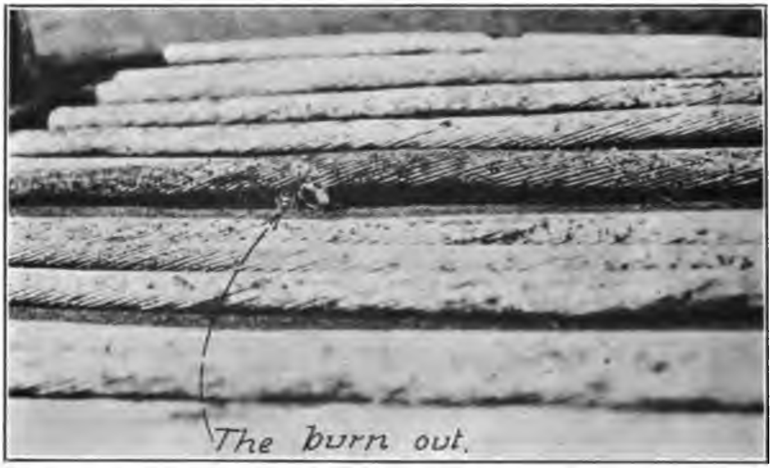


Fig. 1. 1123

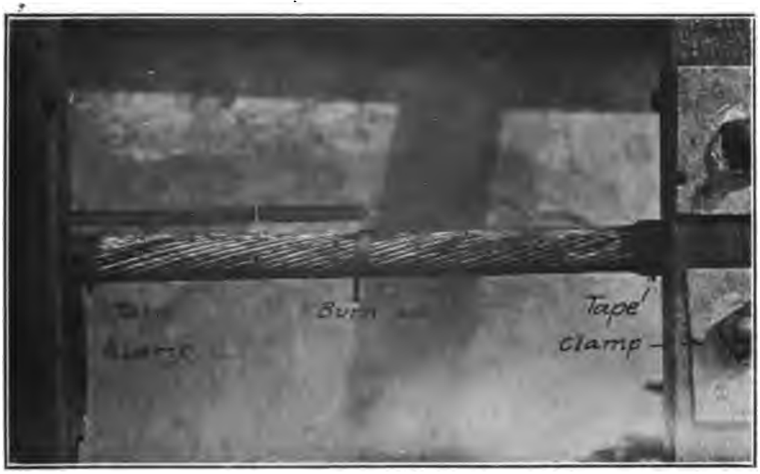


FIG. 6. 1124

Ready to bird-cage

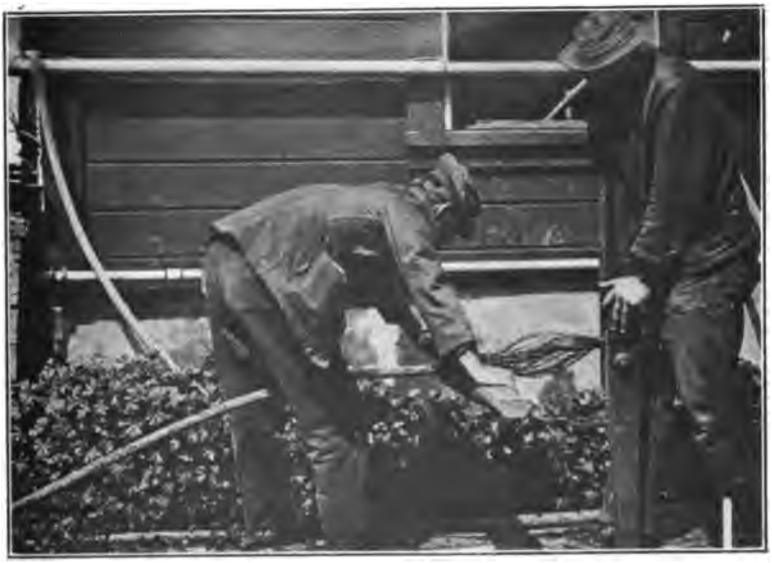


FIG. 7. 1125

Bird-caging

On 19-conductor cables, these clamps are placed 22 inches apart. The armor is wrapped with Manson tape on both sides of each clamp to assist in limiting the effects of the caging. The taping is better shown in Fig. 13. One clamp is then held vertically as shown in Fig. 7, while the other one is turned clockwise until the caging is formed as shown in Fig. 8. The armor wires are now separated as shown in Fig. 9, and the jute covering is cut and laid back as shown at left of photograph. The lower ends of the clamps are then placed a little closer together (Fig. 3) and held firmly in place while the tops are forced towards each other. This buckles the caging and leaves the conductors loose enough to be pulled apart for working as shown in Fig. 9.

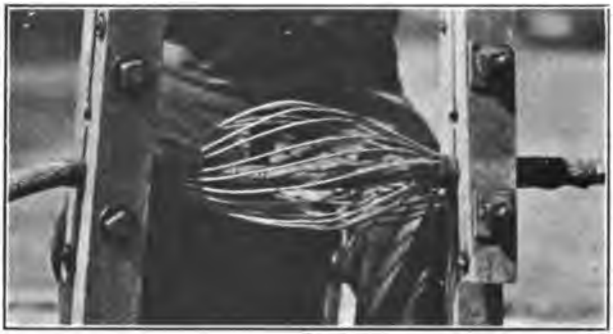


FIG. 8. 1126
The bird-cage

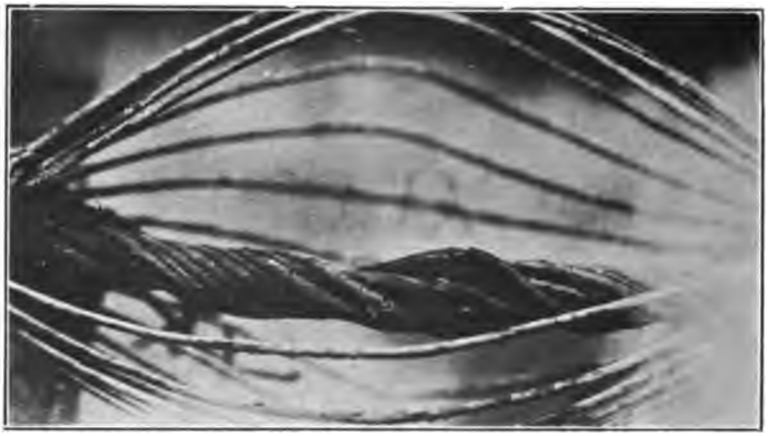


FIG. 9. 1127
The fault, and the kink which caused it

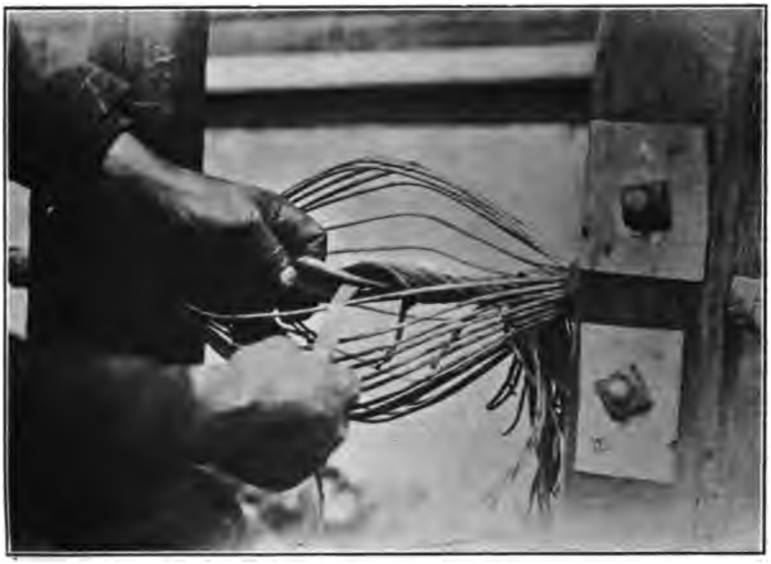


FIG. 10. 1128

Insulating with okonite tape

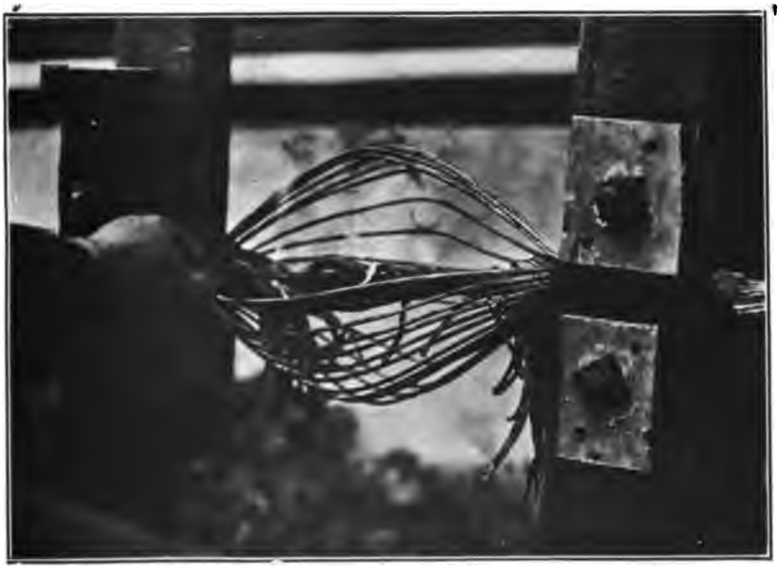


FIG. 11. 1129

Vulcanizing

Repairing works.—The burn out is then located and cleaned. It is usually located at a kink in the conductor wire as shown in the photograph. This however is not necessarily a kink in the cable and seldom is. In subjecting the cable to a heavy strain as a straight pull in raising, or possibly a sharp turn, the armor wire being wound spirally stretches more than the conductors, without a *set*. Upon relieving the strain the armor wire returns, drawing the conductor back into a kink. In this case the conductor is 7-strand. Only one strand was kinked badly. This pressed outward through the insulation causing the fault. The burn out also burned the two adjacent conductors above and below. The upper one is clearly shown in the photograph. All three had to be cleaned and repaired. Usually one or two good ones are injured but when repaired they are probably better than before as a thick layer of insulation is applied. The old insulation is trimmed down with a long taper and scraped to give a rough surface. Rubber cement is then applied, and allowed to partially dry, when the okonite tape is put on tightly in several layers (Fig. 10) until slightly larger than the old covering. This is then covered with Manson tape and vulcanized by means of an alcohol or gasoline flame (Fig. 11). The usual care must of course be taken not to burn the okonite tape during vulcanization. It is kept as hot as the mechanic can bear on well seasoned fingers and thoroughly rolled and massaged. The Manson tape is not removed, for after some experience the mechanic soon learns

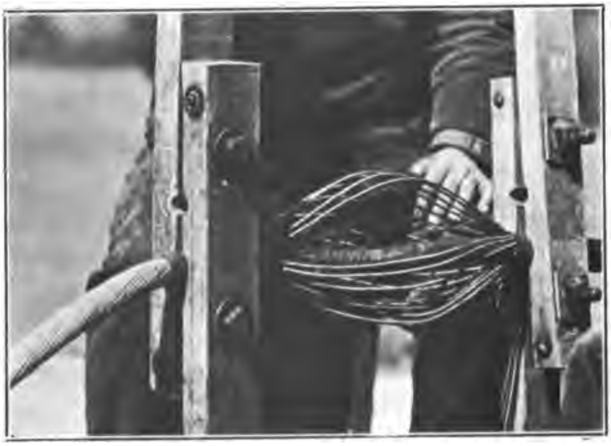


FIG. 12. 1130

Ready to re-armor

to vulcanize so well that an inspection of the repairs is unnecessary. They never burn out where repaired. After all conductors are repaired the jute is laid back evenly and the whole wrapped with Manson tape as shown in Fig. 12. The armor is then laid back and is wrapped with marline. Fig. 13 shows the process of wrapping, also a finished job at the top. Marline is used for wrapping as it is more pliable than wire and interferes less in handling. It can be readily renewed at any time and so far has offered no disadvantages. In Fig. 13 the armor having been strained from the bird cage previously formed in repairs just to the right, did·not return to its place as well as usual. This particular cable has burned out 25 times and is practically hopeless. It is an old 1898 "left over".

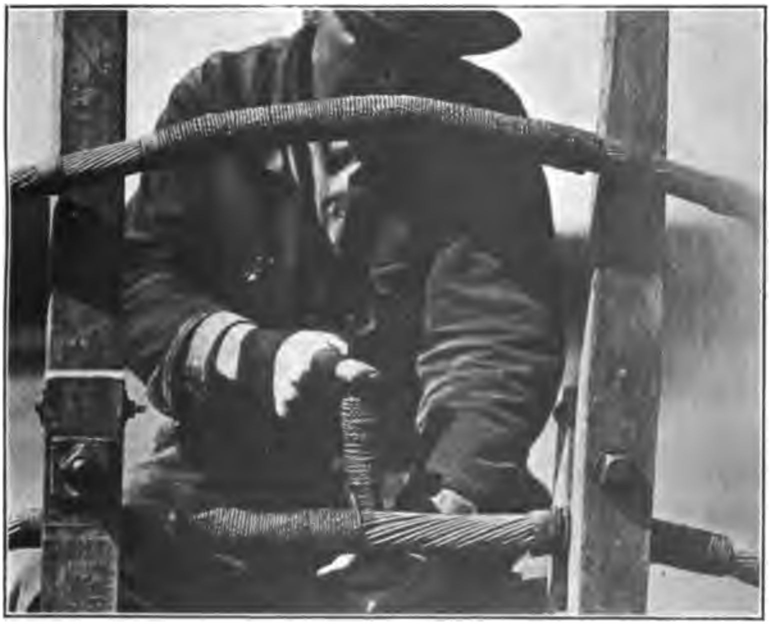


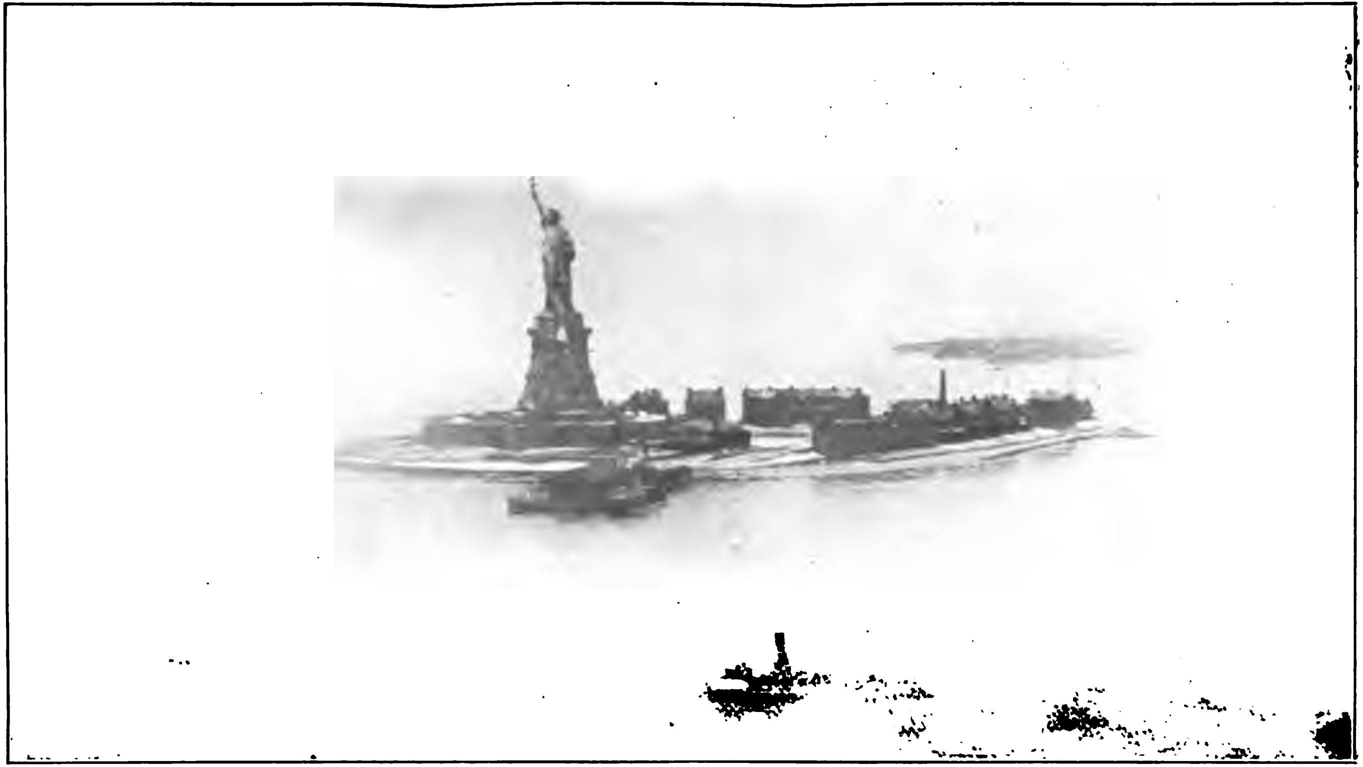
FIG. 13. 1131

Serving

Most of the repair work so far has been on old class "B" cable. Most of that which has been worked on has been brought up to class "A" but it is far from being "A-1" cable. It is the present intention that in the future, preference shall be given to the Class "A" cable on hand. This generally has a few bad conductors and can readily be made "A-1." Further efforts can then be made to bring up the old cable. Some of this however can not be improved. One reel burnt out in 54 places and another in 66 and finally tested worse than before the repairs were undertaken. In these cases the insulation is so brittle or rotten it breaks whenever handled.

Much credit in this work is due Master Electrician S. B. Owens, C. A. C., now at Fort Du Pont, Delaware. The instrument and battery insulation were first suggested and used by him and it was only after using these the first season that the wet weather results later obtained seemed possible. During the past season Master Electrician James H. Wetherholt, C. A. C., has offered valuable suggestions and services.

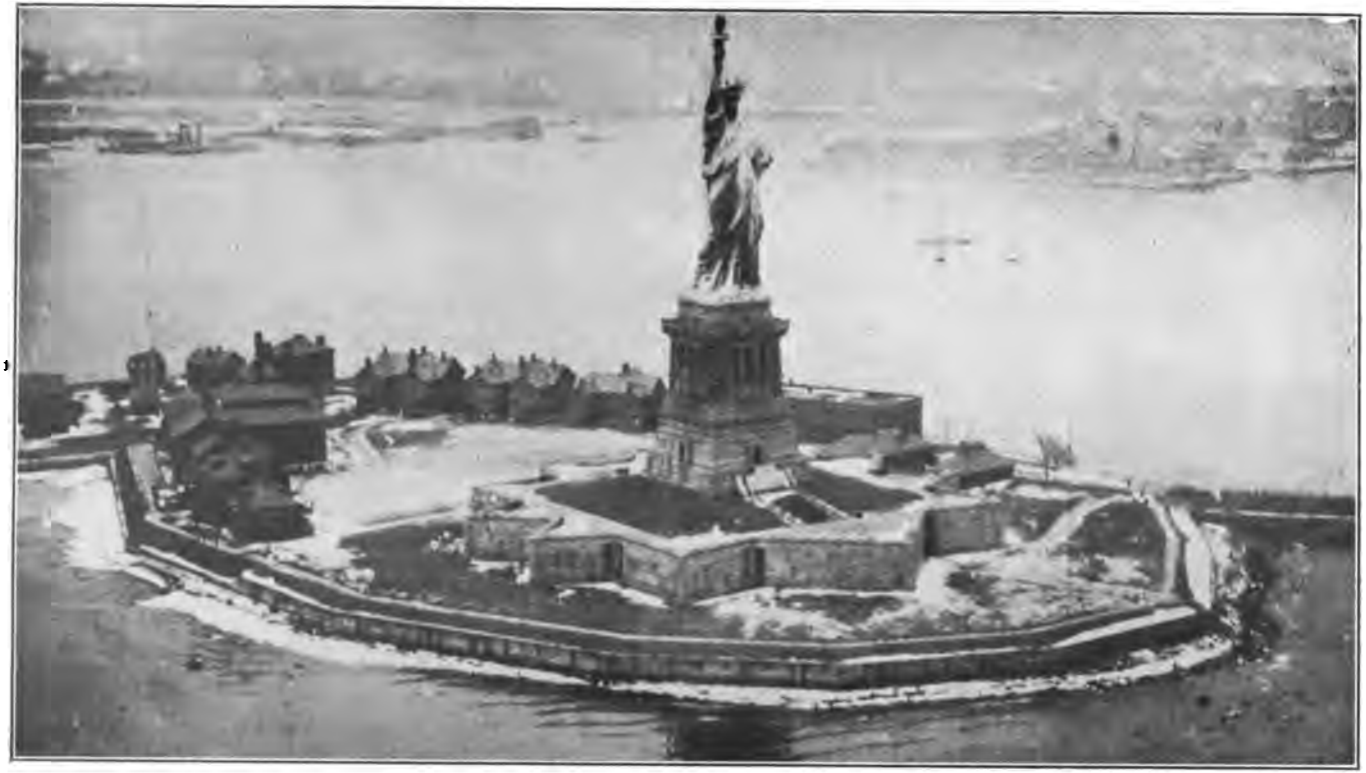
Respectfully submitted,
J. C. Johnson,
Major, Coast Artillery Corps,
Acting Artillery Engineer.



Courtesy of American Press Association 1132

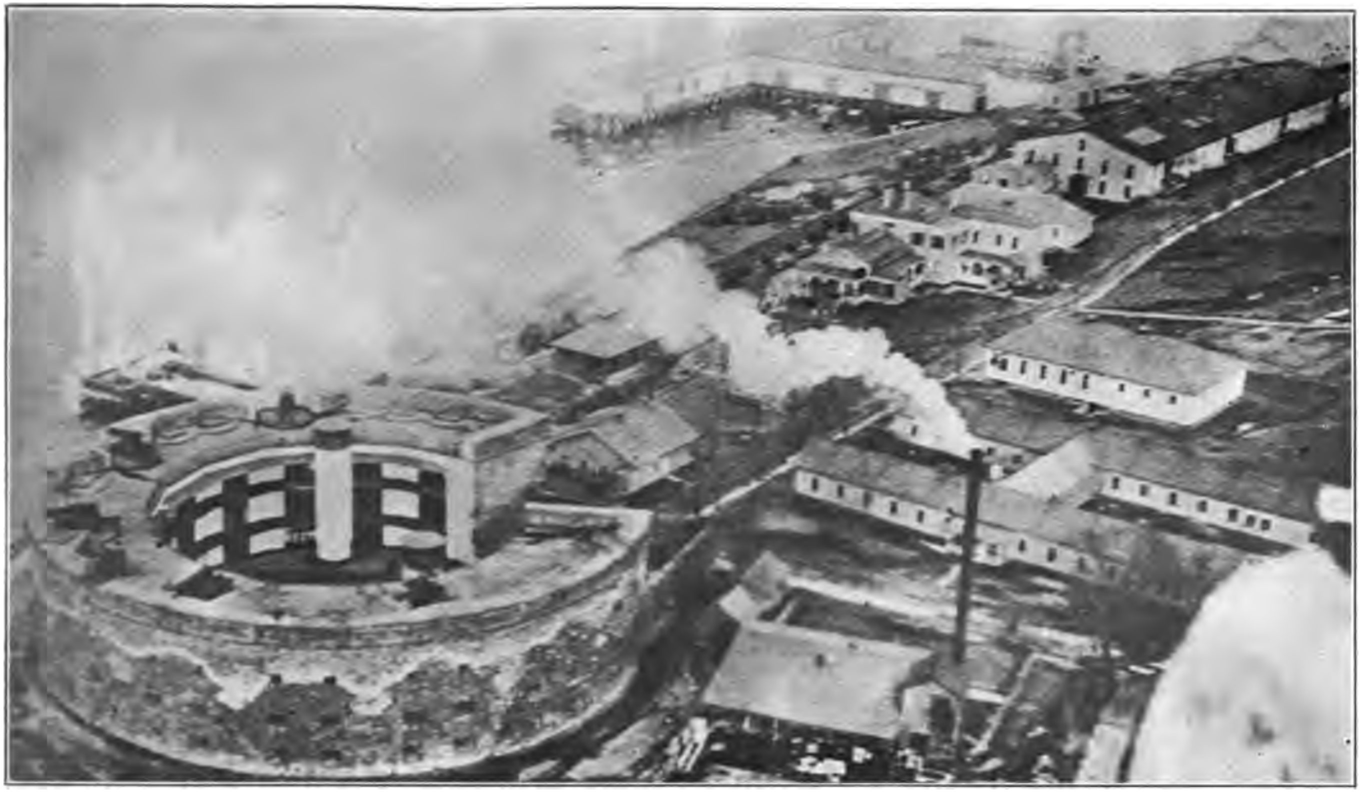
FORT WOOD, BEDLOE'S ISLAND, NEW YORK HARBOR, SHOWING THE GODDESS OF LIBERTY

The four pictures here shown were taken from an aeroplane by Dr. David A. Murphy, Manager, Photo-News Department, American Press Association. They are remarkable for the amount of detail shown,—indicating the extreme importance of aeroplanes in military reconnaissance



Courtesy of American Press Association

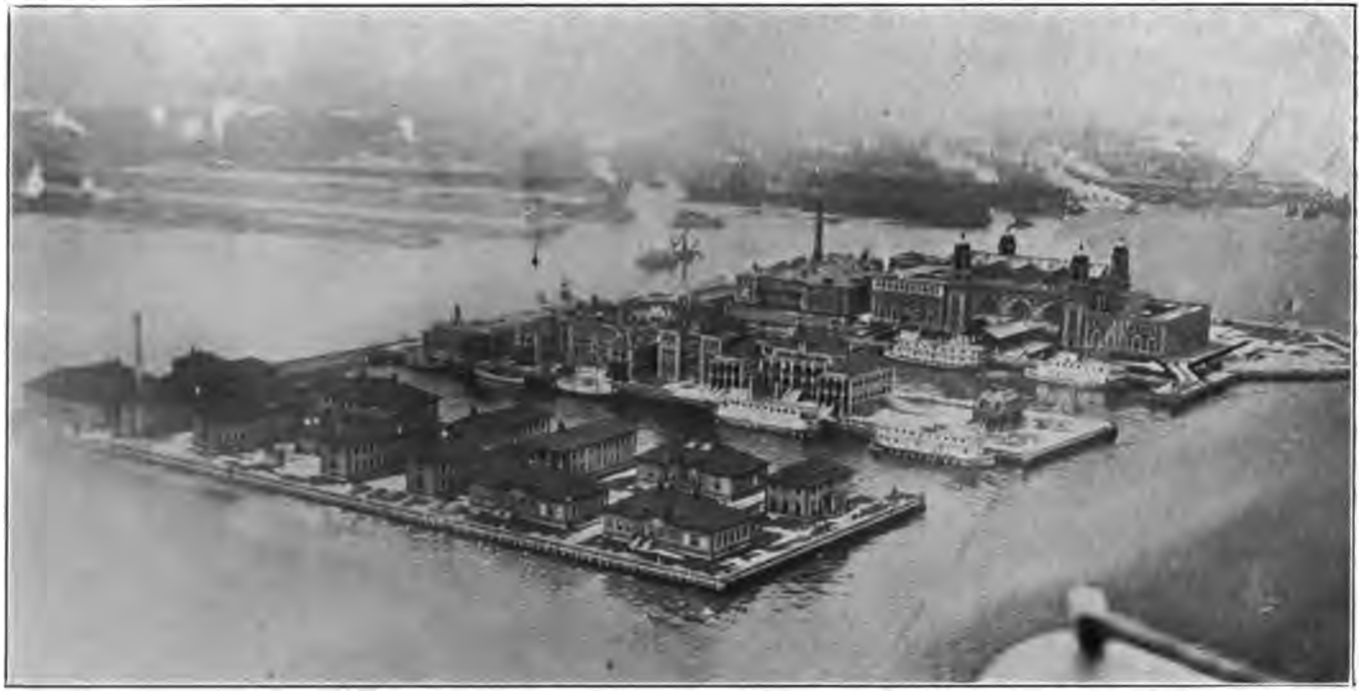
Another View of Fort Wood
(56)



Courtesy of American Press Association

GOVERNOR'S ISLAND, NEW YORK HARBOR, FORT JAY IN THE FOREGROUND

(57)



Courtesy of American Press Association

Ellis Island, New York Harbor
(58)

PROFESSIONAL NOTES

SUBMARINE MINE DEFENSE OF COAST FORTRESSES*

(Concluded)

CHAPTER II.

A LARGE FORTRESS†

Reconnoitering of the Fortress. (Fig. 9, opposite page 66).

The port where the vital parts of the fortress are concentrated is located in the depth of the bay, the approach to which from the sea is protected by two islands. The entrance to the port is covered by two moles. From the sea there are three passages leading into the port; from the east a broad and deep one, a middle one, also broad and deep, and a northern one, sufficiently deep, but narrow; this last one may be obstructed by fireships.

The batteries of artillery A, B and C are placed at a distance of 9 to 10 versts (6 to 6⅝ miles) from the port; they are armed with 10-inch and 12-inch guns (there are also naturally 11-inch howitzers) so that no attempt on the part of the enemy's fleet, even a bombardment of the port, carried out from a distance of 12 versts from the same, will be allowed to go unpunished, as the 12-inch guns will cover this distance easily.

The right flank of the coast front, to the east of the cape "Eastern" is the weakest point of the defense as from this point the vital parts of the fortress may be bombarded. This fact must be taken into consideration in projecting the mine defense of the fortress and several banks of mines must be placed here. In making a choice of the types of mines it will be necessary, it seems to us, to remember first of all that the fortress must serve as base for the *active* fleet, which consists of important service units, and secondly, that the dangerous point, mentioned here, is not the bay which we do not intend to use, but that the said point lies on the way of our ships in case they should move out to the east of the fortress. It would therefore be more efficacious to place here electro-contact stationary mines, and not electro-percussion ones.

The fortress in question does not require an offing barrier to be placed (excepting the above mentioned banks on the right flank), because the roadstead barrier will serve the same purpose.

For the support of the batteries A, B and C during an engagement with the enemy's fleet a roadstead barrier must be placed in a zone traced by radii of 6 to 8 versts from the batteries.

For this purpose, assuming the batteries A, B and C to be centers, we trace by means of the above mentioned radii arches up to the point of their intersection with one another and the coast; we obtain a curve—D E F G D_1 E_1 F_1 G_1. However, for the purpose of a more convenient placing and removing of the barrier, and bearing in mind at the same time that the latter need only be brought up to about 2 versts from the coast, where a battery of Whitehead torpedoes may be placed, we will act in the following way: On the continent and on the island will be placed shutters aa, a_1a_1, a_2a_2, a_3a_3, by means of which we indicate the area K L M N K_1 L_1 M_1 N_1, where we will place the roadstead barrier. In calculating the number of mines, we must remember that the right flank is defended only by battery C, therefore the barrier must be specially enforced at this point.

---

* Continued from JOURNAL U. S. ARTILLERY, May-June, 1912.

† The locality taken is purely theoretical; the depths are 35 to 150 feet, the dotted line indicates a depth of 20 feet.

Passing over to the defense of the issues, we remark the following:

a. The northern issue, a narrow one, may be blocked up by fireships.

b. The middle issue—owing to the contours of the coast, allows observation ground mines to be applied; this is desirable also for the reason that this is the issue which will be used frequently by our own ships.

c. The eastern issue—must be most carefully protected from being broken into from the east, above the coast.

Lastly, for the protection of our fleet, when stationed in the inner roadstead, behind the moles, from torpedo attacks by small torpedo boats and cutters, it would be desirable to cover the entrance to the inner roadstead by a boom.

That is how we imagine a submarine defense of a large fortress would have to be carried out.

Details of Mine Barriers. (Fig. 10.)

1. The offing barrier—to the east of the "Eastern" cape—consists of 7 separate banks, by 6 mines per bank, in all 42 floating electro-contact mines. The area occupied by this barrier is equal to approximately 12 square versts —(approximately 8 square miles), consequently about $42 \div 12 = 3\frac{1}{2}$ mines per square verst. One main conduit, a seven-corded one, only. The depth at which the mines are sunk is 20 feet, for the reason that they are destined to act against large vessels, from which it is possible to bombard the port, and also because at this point the sea may be very rough. The distance between the mines and the magazine is 100-125 sajens (700 to 875 feet). For the observation of this barrier, as well as of the right flank of the roadstead barrier, there is an observation point No. 1 near the "Eastern" cape. The management of this barrier is concentrated at station No. 1, which is connected by a special telephone with observation point No. 1.

2. The roadstead barrier is laid in the form of a stripe, 2 versts broad, at a distance of 6 to 8 versts from the batteries A, B and C, and 2 versts from the coast; the flanks are protected by batteries of Whitehead torpedoes. The right flank section of this zone is of the most importance, not being under the cross fire of our batteries; it is covered only by battery C, after the fall of which the operations of the enemy's land forces will be considerably facilitated. For this reason the right flank must be more strongly mined.

For the purpose of calculating the number of mines necessary for the roadstead barrier, we must divide the zone into two parts: For the right flank, measuring an area of about 12 square versts we must reckon 10 mines per square verst, for the remaining area (26 square versts) 5 mines per square verst will be sufficient. Hence there will be in the entire roadstead barrier:

$$(12 \times 10) + (26 \times 5) = 120 + 130 = 250 \text{ mines.}$$

As the placing of the mines in the form of a "star" is the quicker and easier way, the same way may be applied on both flanks of the barrier; in the center of the zone, however, the mines will be placed "in a line," by 10 mines in each group, as we suppose this part to be the chief line of movement of our own ships. For their passage we give four secret shutters or slides (the plan shows 4 of them: 1 on island C and 3 on island B), consisting of high masts, to be raised in case of need with distinguishing signals.

The mines of this barrier must be floating electro-contact ones; their depth 16′ to 18′. Ten mines on one main conduit; one cord of the middle seven-corded cable is carried out to some distance on a buoy to enable the sentinel ships to cummunicate by phone with the station in case of fog, stormy weather, during night time, etc.

The removal of the zone of the roadstead barrier, if conducted in the way mentioned above (see reconnoitering of the fortress, Fig. 9) will not present any difficulties; as to the removing of the barrier itself, the same will consist in the removal of the magazines, on the flanks where the "stars" are placed, (the distance between the magazines of one main conduit being reckoned as 1 verst, viz. ⅔ mile); in the center, where the mines are placed "in a line" the places where they are laid must be rendered innocuous in the usual way.

For the purpose of watching over the barrier there are observation points No. 1, 2, 3 and 4, connected by telephone with stations No. II and III, where the management of the barrier is concentrated.

3. The barrier of the inner defense consists of three parts:

a. The northern part—between the continent and island B—protecting the narrow issue. Fireships may be dangerous to it; they will probably come from the sea, but in no wise along the coast, as there we have battery A. We will therefore bar only the part lying nearer to island B. The remaining passage may be protected from the side of the sea by a traverse.

The barrier carried forward to a distance of 2½ versts (⅔ miles) from the narrow issue, consists of three rows of floating electro-contact mines; the distance between the rows being 75 sajens (525 feet), the distance between the mines of each row = 30 sajens, (210 feet), the depth* = 6 to 7 feet; from 10 to 15 on each main conduit, the latter being a one-corded cable. The traverse also consists of 3 rows of mines; the details are the same. In all 75 + 45 = 120 mines.

The observation point for this barrier is at No. 5, connected by a telephone with station No. VI, to which the main cables are conducted.

b. The middle part, between the islands B and C. This passage, where the chief movement will take place may be divided into two sections: The right flank one, barred by floating electro-contact mines placed at a depth of 6 to 7 feet and at a distance of 30 sajens one from the other in 3 rows (the distance between the rows being 75 sajens) by 15 mines on one single-corded main conduit, and the left flank section, barred by observation ground mines, placed in 3 rows in chess board order, with a distance of 30 sajens between the rows and the mines of each row. In all 75 floating mines and 31 ground mines.†

The observation point of the right flank section No. 4 is at station No. IV in the same place as station No. II; for the left flank—stations No. V and Va.

c. The eastern part—between the continent and island C. The barrier consists of two parts, disposed in *echelons* for the purpose of forming a passage. Each part consists of 3 rows of floating electro-contact mines placed at a depth of 6 to 7 feet, and at a distance of 30 sajens one from one another. The distance between the rows is 50 to 60 sajens (350 to 420 feet) the main conduits are single-corded; from 10 to 15 mines on each main conduit.

---

* Against squadron torpedo-boats.

† The drawing shows only 17 mines, as in consequence of the small scale there was not sufficient place for all.

Observation point—No. 6 Station—No. I (with an offing barrier). In all 75+60=135 mines.

Thus the whole system of defense will require 632 floating electro-contact mines and 34 observation ground mines.

To the same type of barriers (inner ones) may be ascribed:

(d) The battery of the Whitehead torpedo D, placed on island B, behind the ground mines, destined to act against the ships which may break through the passage, and

(e) a boom barrier protecting the entrance into the harbor.

In regard to the order to be followed in placing the barriers enumerated above, we are of the opinion that the following one should be observed:

(a) The offing barrier (42 mines),
(b) The Eastern inner barrier (135 mines),
(c) The right flank roadstead barrier (120 mines),
(d) The middle inner barrier (75—34 ground mines),
(e) The left and middle parts of the roadstead barrier (130 mines),
(f) The northern inner barrier (120 mines),

as it may be presumed, that after war is declared the enemy will attempt to bombard the port or to break through to the rear of the batteries, both courses being possible and the more easily effected on our right flank, wherefore this flank must be defended in the first place. As regards the middle inner barrier, the left flank and the middle part of the roadstead barrier—they are of equal importance and lastly, the northern inner barrier—of the least consequence.

First of all, however, to be protected from sudden attacks it is necessary to establish a boom.*

The mining camp is situated in the port:

a. The mine stores must have an area of shelves approximately (650×12)+(40+20)=approximately 9000 square feet.

b. Landing places, counting 3 mining companies,—must have 120 sajens (840 feet) in length, 3 sajens (21 feet) in breadth.

c. Stores of explosives—for a "requisite" quantity of the same.

The headquarters of the commander of the mine defense in the mining camp are directly connected by telephone with all the mine stations. For the defense of the barriers there should be "barrier batteries" consisting of 6-inch Canet and 120 mm. guns.

It is thus that we presume a submarine mine defense of a large coast fortress should be organized. Naturally in reality there may be some modifications, according to circumstances; it may be that the mine banks will admit of a smaller quantity of mines in the roadstead barrier, maybe it will be possible to give up the eastern passage and only fill it up with electro-percussion mines, possibly also that the depth of the middle passage will not allow of the application of ground mines—it is impossible certainly to forsee all these conditions in a purely theoretical locality and with a presumed uniform depth of the sea.

---

* We think it would not be amiss if the entrance into a military port would be protected by a boom even in times of peace, because for a military port as well as for a fortress there should be no times of peace.

The defense of a quasi-large fortress will differ only in so far that it will be absolutely necessary to place an offing barrier. Consequently, the number of mines will be increased, and at the same time the time necessary for the placing of the barriers will also be increased, (though not proportionately).

Chapter III.

SMALL FORTRESS

In regard to a submarine mine defense small fortresses must be divided into 2 categories: To the first belong all fortresses which serve exclusively as a base for flotillas of mine boats and represent a natural bay (Fig. 11), to the second, mouths of rivers, with bars, *i. e.*, sand banks reaching far out into the sea; such fortresses may serve either as base for torpedo-boats or as a covering for the narrow entrance into the river,* which might become blocked up by fireships (Fig. 12). The defense of the strait or broad mouth of the river may be entrusted to the coast position,—this case will be dealt with in the following chapter.

1. We will first take the former case: Supposing, we have a small fortress, representing a small inland bay (Fig. 11) the entrances to which lie:—one between cape B and island A, and the other between the same island and the continent. The batteries of artillery A and B are placed on the island and on the cape.

The enemy will evidently not attempt to bombard our bay—as this will not bring any results. Consequently, we need not trouble ourselves about placing an offing barrier.

Passing over to the examination of the conditions of a conflict between a fleet and the coast artillery in the locality in question, we determine the zone of the fleet's maneuvering by drawing arches, in radii of 6 to 8 versts (4 to 6 miles), assuming the batteries to be the centers. Having accomplished this we see that the middle part of the zone (14 square versts viz., 9½ miles) comes under the cross-fire of the batteries, so that we may presume that for this part 5 mines per square verst will be sufficient; this would make in all 14×5=70 mines disposed on 7 main conduits. These mines would be placed in "line" groups (by ten mines per group) directing the fronts of the lines along the radii. The distance between the mines would be 50 sajens (350 feet), the depth—14 feet; the flanks of the zone present convenient positions for the enemy's fleet, therefore the roadstead barrier must be enforced at this point; we would make it 10 mines per square verst, —thus, as the area of these flanks is 9×2=18 square versts the number of mines would be 18×10=180 mines on 18 main conduits. The groups must be placed "in stars" at a distance of 60-75 sajens (420 to 525 feet) from the magazine,—the depth at which the mines are to be sunk is 14 feet.

Hence, the total number of the mines forming the roadstead barrier will be 70+180=250 mines, disposed on 250 ÷ 10=25 main conduits. The observation points must be placed on the flanks of the barriers No. 1 and 2 and at the stations, which must be erected near the batteries A and B.

On the right flank of this zone there is a small bay, which may be of great service to the enemy—it cannot be left unprotected; it can hardly be of any use to us, therefore the best would be, we presume, to fill it with electro-percussion mines with a reduced charge, at shortened intervals, in three rows; the distance between the mines we will assume to be 20 sajens (140 feet), between the rows—50 sajens (350 feet), the depth—6 feet. The number of mines would be 225. The front of this "line" barrier must lie along the shutting of battery A and cape B, so as to annul at the same time the dead space which may lie behind the cape. The observation point No. 2 is the same as for the roadstead barrier.

---

* For instance, an approach to a large commercial town.

The barrier of inner defense must be placed along the lines of the batteries, for the purpose of protecting the entrances into the bay. The passage between A and B will probably have to be barred by means of floating electro-contact mines, and in the passage between A and the continent it may be found possible to apply ground mines (conformably to the depth of the sea), as the locality seems favorable thereto.

In calculating the number of floating mines for this barrier, placing them in 3 rows, with intervals of 50 sajens (350 feet) between the rows and 30 sajens (210 feet) between the mines, at a depth of 6 feet, we see, that the total number of mines for the barrier of inner defense will have to be $\frac{1500}{30} \times 3 = 150$ mines. The stations and observation points will be the same as those for the roadstead barrier, namely, near the batteries A and B.

There will be no need of a boom, because (1) the fortress has no active fleet, and (2) it does not protect either the entrance into a river, nor a commercial port.

Thus the mine defense of such a fortress will require 400 floating electro-contact mines and 225 electro-percussion ones.

The question of the order in which the works must be carried out should be thoroughly discussed from all points of view. It must be assumed that in a small fortress the artillery will hardly answer all the up-to-date requirements and therefore, in a conflict with a fleet, it will not have the great advantage, which it possesses under normal circumstances. Hence, we may presume that on approaching such a fortress a fleet will be able to proceed to a conflict with its artillery with a fair chance of success. On the other hand, we may assume, that the fleet will attempt to force the passage and penetrate to the rear of the coast batteries—though this supposition will hardly be justified, as it is difficult to believe, that the home torpedo flotilla in the fortress will remain wholly inactive.

Therefore, we think it would be right to place first a roadstead barrier, beginning the same from the flanks, and afterwards to place a barrier of inner defense.

2. We shall now take the second case (Fig. 12):

A small fortress is situated at the mouth of a river, with sand banks projecting far out into the sea. A, B, C, and D represent the batteries of artillery. It is possible to expect that the issue (the only one) will be blocked up by fireships; up along the river there is a commercial port and it may be that small ships will break in for the purpose of carrying out torpedo attacks against the commercial ships in the port. The dotted line represents a depth of 4 feet.

The absence of an offing barrier is evident. The place where the roadstead barrier must be disposed may be determined by the method already mentioned. After determining it we will see that in the center the zone of the roadstead barrier coincides with the place to be occupied by the barrier which is to protect the entrance into the river from being obstructed by fireships (2-2½ versts, or 1½-1⅔ miles from the narrow part). The preference will have to be given to the barrier against the fireships, as should the entrance become blocked up—the fortress will be worthless.

We will now endeavor to determine the limits of such a barrier, bearing in mind that a fireship can only move in a straight line: (a) from the right flank the narrow part is protected by the projection of the sand bank, therefore we consider that it will be sufficient to bring the barrier up to the limit shown on the drawing, (b) from the left flank the narrow part is more open; here we have to be guided by the consideration that the fireship will not move alongside of the coast, that is to say, under the fire of battery D; therefore we consider that it will be sufficient to bring the barrier up to the limit shown on the drawing and to place a supplementary *echelon* behind the left flank.

The roadstead barrier may be placed in the zone determined before, with deduction of the area, taken up by the barrier against fireships; it need be brought up to a distance of about ½ or ¾ of a verst (⅓-½ mile) from the latter and 1 verst (⅔ mile) from the sand bank (not 2 versts, because we presume that according to the conditions of the locality it will be impossible to place a battery of Whitehead torpedoes).

Lastly, to prevent the breaking in of smaller ships into the river we will place a boom on the line of the batteries B and C.

In regard to the details concerning the proposed mine barriers, we will assume the following:

a. The left flank covering an area of 7×2 = 14 square versts (9½ miles) will need 140 floating electro-contact mines, on 14 main conduits (two seven-corded cables); the mines to be placed "in stars" at a depth of 12-14 feet and at a distance of 50-60 sajens (350-420 feet) from the magazine. Station—No. 1, observation points—No. 1 and 2.

b. The right flank, with an area of 8×2 = 16 square versts (10⅔ square miles) is barred by 16×10 = 160 floating electro-contact mines, placed "in stars" along 16 main conduits (one—a seven-corded cable and two—five-corded cables); the other conditions are the same as on the left flank; station No. II, observation points No. 3 and 4. In all, the roadstead barrier will have 140+160 = 300 mines.*

c. The center—is barred by a "line" barrier, consisting of 3 rows of mines; the distances being: 75-100 sajens (525-700 feet) between the rows, 30 sajens (210 feet) between the mines; the mines are floating electro-contact ones placed at a depth of 10 feet.

The number of mines in the barrier is $\frac{7\times500}{30}\times3=350$, and in the *echelon placed at a distance of 400 sajens* (2800 feet) at the back of the left flank $\frac{750}{30}\times3=75$ mines, total 350+75 = 425 mines. Main conduits $\frac{425}{10}=42$, as on a distance of 6 to 8 versts it would not be rational to place more than 10-11 mines on one conduit. Evidently, six seven-corded cables would have to be used. The management of the barrier must be entrusted to stations No. I and II, and the observation—to posts No. 2 and 3.

Thus there would be needed for the defensive barriers of the small fortress in question:

---

* Seeing that the chief object of a coast front is to protect the passage, it would be possible, we think, to reduce the number of mines near the batteries A and D to 5 per sq. verst. The total number of mines in the roadstead barrier would be thus reduced by half; instead of 300 mines—150 will be sufficient, the same may be placed on 2 seven-corded main conduits, (by 11 mines per main conduit).

300+425=725* floating electro-contact mines and one boom.

This is undoubtedly a great number, but it is called forth by:

(a) The straight line of the coast,

(b) the projecting narrow entrance into the river which it is necessary to protect from being obstructed by fireships, and

(c) the necessity of preventing a mine attack against the commercial port.

As a matter of fact, such a small fortress covering the approach to a large commercial town, is of no small inportance, notwithstanding its modest dimensions; and if one remembers all the disadvantageous conditions of the locality, the comparatively great number of mines, apparently so disproportionate to the modest dimensions of the fortress,—need not seem surprising.

In addition to all that has been said on the subject of the mine defense of small fortresses we deem necessary to mention that according to our opinion the distance at which a roadstead barrier should be placed from the batteries of artillery must not depend on the condition of the coast artillery; a *fleet* owing to its mobility, will always *choose* for itself a convenient *distance* from which it may engage in combat with the coast. If the coast artillery is of an old system this should not mean, that, in placing the barrier, this fact ought to be taken into consideration; that is to say, that the barrier should be placed nearer to the coast. The enemy's fleet would only profit thereby and destroy the coast batteries *with perfect impunity for itself.* A roadstead barrier must *always* be placed at such a point which would be convenient for the home fleet (in a small fortress with artillery of the old type a roadstead barrier will *to a certain extent* play the part of an offing barrier in regard to its own batteries) although the "harmony between the gun and the mine" be thereby infringed.

CHAPTER IV.

COAST POSITIONS

Fortified positions on the coast are employed for the protection of mouths of rivers, inner channels, etc., and in general in such places where a fleet cannot be deployed for a combat with the coast. This facilitates the task of the coast defense: The artillery forces may be reduced.

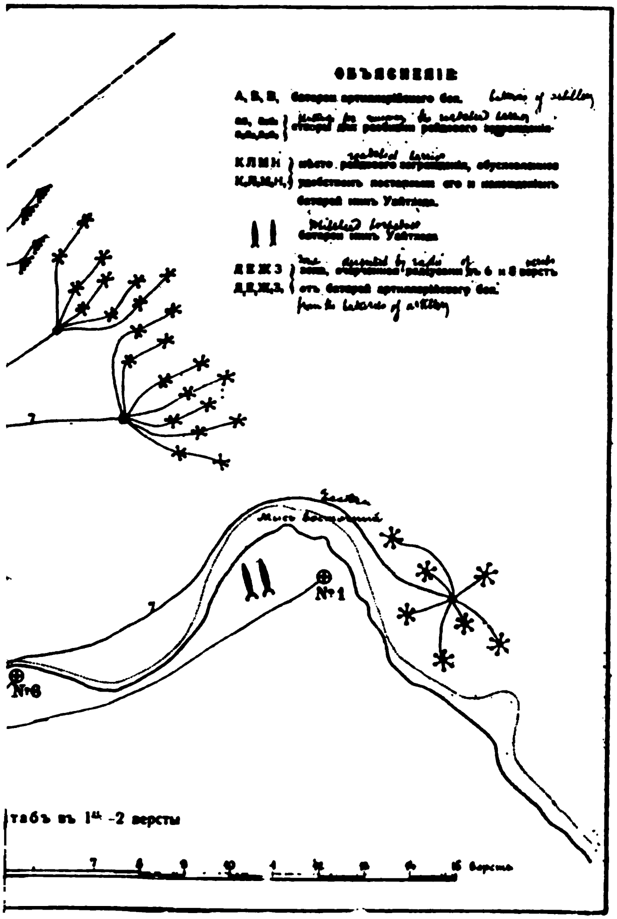
For instance, (Fig. 13), we assume that the channel must be defended and the enemy not allowed to penetrate to the east of battery A, which covers this channel. It is necessary to render this passage inaccessible to any of the enemy's ships, from the large line ships to the smallest torpedo cutters. As our task is such an important one, we will have to take measures to: (a) assist battery A in its combat with the fleet, (b) prevent the enemy from blocking up the passage by means of fireships, and (c) not allow small torpedo boats to pass through the channel.

In carrying out the first part of the task we must bear in mind that the enemy cannot deploy his forces. Consequently, the barrier must be placed at such a point where the enemy would be able to cover our battery with fire; this barrier placed in a spot covered by our own fire, must prevent the enemy from passing to a more convenient and near position.

We presume that these conditions will be best answered by a barrier placed SW from battery A; it must be placed across the passage in three rows and the entrance on the right flank covered by a traverse (more rightly

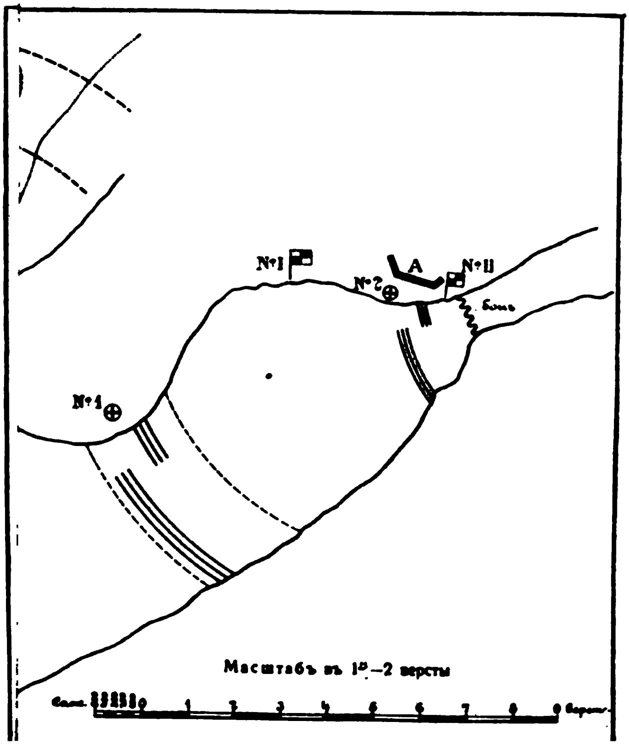
---

* Or see preceding note: 150 + 425 = 575 mines.


ОБЪЯСНЕНІЕ
А, Б, В, батареи артиллерійского боя. batteries of artillery
мѣсто рейдового загражденія, обусловленное удобствомъ постановки его и наблюденіемъ батарей минъ Уайтхеда.
Whitehead torpedoes
батареи минъ Уайтхеда
ДЕЖЗ
Д,Е,Ж,З,
въ 6 и 8 верстъ
отъ батарей артиллерійского боя.
from the batteries of artillery
№1
№6
табъ въ 1дм -2 версты
версты

IG. 10.

1:36


№1
A
№11
№2
бонъ
№4
Масштабъ въ 1дм.-2 версты
0
1
2
3
4
5
6
7
8
9
верстъ

speaking by an *echelon*) carried back to a distance of 400 sajens (2800 feet) and composed also of three rows of mines. For this purpose there will be needed $\frac{4\times500}{30}\times3=200$ mines disposed on $\frac{200}{10}=20$ main conduits, consisting of three seven-corded cables. The distance between the mines must be 30 sajens (210 feet), the depth, we think, 12 feet, this barrier would thus serve also against fireships; the distance between the rows of mines must be 75 sajens (525 feet). No. 1 shall serve as observation point, No. 1 as station (with a separate protection).

For preventing large (squadron) torpedo boats[*] from breaking through, a second barrier shall have to be placed under the near fire of battery A, at a distance of 1-2 versts from the battery and across the passage; it must also consist of three rows of mines (with a distance of 50 sajens or 350 feet between them) with a reduced charge (2 poods—about 72 pounds) at shortened distances (about 20 sajens or 140 feet) and at reduced depths (6-7 feet); a passage may be formed by the rows being placed in *echelon* order. It will need $\frac{500\times3}{20}\times3=225$ mines for the three rows; main conduits $\frac{225}{15}=15$; the station No. II may be placed near battery A, observation post at No. 2.

Lastly, as a measure against small ships, a boom may be placed in the narrow part of the passage. Thus, for the defense of a coast position, we shall want (a) 200 floating electro-contact mines with a normal charge, (b) 225 similar mines with a reduced charge and (c) a boom.

We think, however, that for the fortress in question there is also another method, differing, however, but slightly from the one just described; should the duty of sinking fireships be removed from the far barrier, then the whole picture would be changed.

In such case:

(a) The mines forming the far barrier will not need to be placed so close one to another and they will have to be laid at a greater depth; assuming the distance between the mines to be 50 sajens (350 feet) we will have $\frac{4\times500}{50}\times3=120$ mines, which may be laid at a depth of 15-16 feet,

(b) the barrier destined to act against the torpedo boats and consisting of 2 poods (72 pounds), mines must be removed forward to a distance of 2-2½ versts ($1\frac{1}{3}$ to $1\frac{2}{3}$ miles) from the narrow part, the distance between the mines must be 30 sajens (10 feet) and the mines themselves contain a normal charge. In this case there will be $\frac{3\times500}{30}\times3=150$ mines. The depth may be the same as before—6 to 7 feet, and

(c) the boom shall be left in the same place.

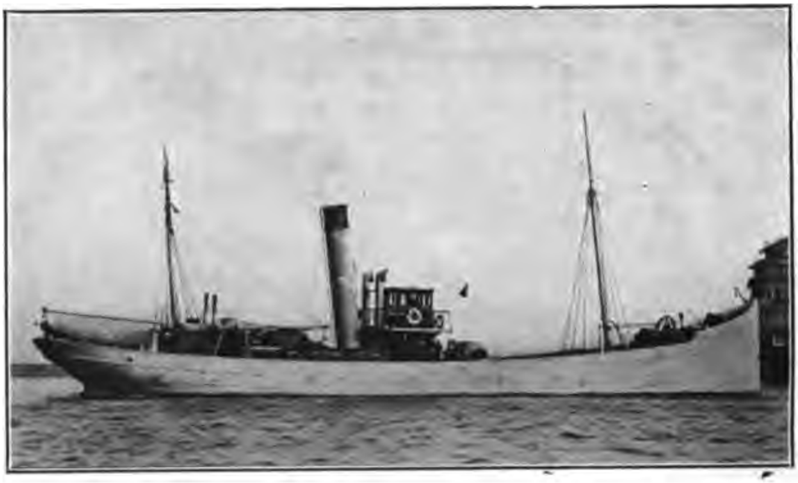
In this case the defense will consist of 120+150=270 mines and 1 boom.

Naturally, should the task be facilitated, *i. e.* should there be no need for defending the channel from being blocked up by fireships (if the channel be very deep, which is frequently the case, say 20 sajens (140 feet), nor for dealing with small vessels, the mine defense would also be much simplified: It might then consist only of a far barrier of 200 mines.

(Continued on page 70.)

---

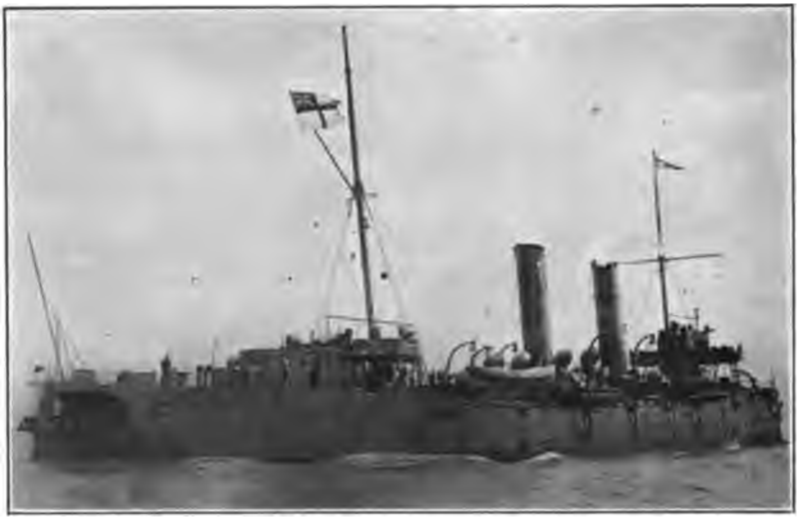
[*] In the examples set forth for the defense of small fortresses we have not taken any measures for protecting our torpedo boats from the enemy's. Here we have no torpedo boats, we only have to prevent the enemy's from passing through to the east of the passage.



Photograph by Stephen Cribb, Southsea 1138

BRITISH MINE LAYER SEAFLOWER

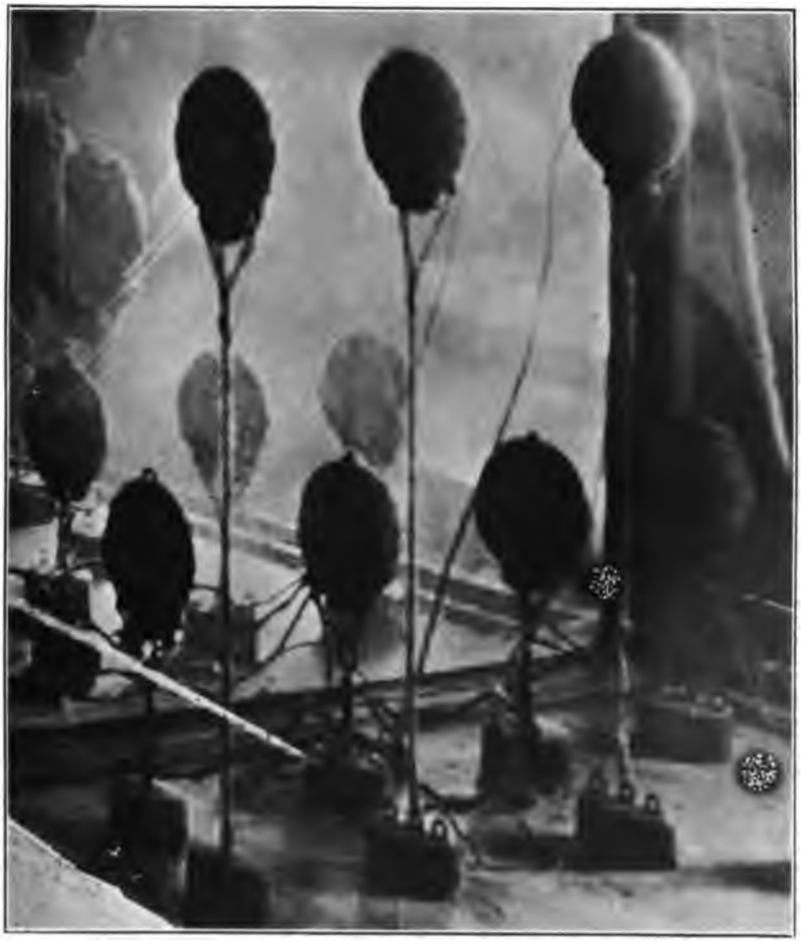
Formerly a North Sea trawler



Photograph by Stephen Cribb, Southsea 1139

BRITISH MINE LAYER IPHIGENIA

She has a double line of rails on each side of the upper deck. These rails project over the stern, which is cut away to form a hatchway. These two ships show the sort of craft used by the British navy for planting mines



Photograph by Stephen Cribb, Southsea 1140

An interesting picture showing electric-contact mines (British) with anchors as they actually are, when planted. These mines are in a tank at the school of instruction

CONCLUSION

In the present essay we have endeavored to give a complete picture of the tactical and technical sides of a submarine mine defense of a coast fortress in the present condition of the coast and marine artillery.

What form such a defense would take with the introduction of new types of artillery guns depends wholly upon the technics of artillery, and submarine mines.

Tactics command:—technics will, undoubtedly, work out such types which will satisfy the tactical requirements.

In conclusion we may be permitted to repeat that we consider our work to be only an "essay at investigation," not more; annexed we deem useful to mention some literature bearing on the subject in question.*

Feci, quod potui, faciant meliora potentes!

—*Engineering Review* (Russia).

◆ ◆ ◆

AUTOMATIC SUBMARINE MINES

Within the past two or three years there has grown up a wide and unhesitating recognition of the great potentialities of the automatic submarine mine. This is a direct consequence of experience in recent wars and of the improvements made in the mechanical features of these instruments of destruction: (1) to ensure safety in handling them on land and on board mine-laying ships; (2) to effect precision in laying them, particularly in respect of the depth of submersion below the surface; and (3) to achieve efficiency in action. Sir George Clarke, a great authority on all matters of defense, wrote some years ago that "the fact that the whole question of submarine mine defense has been allowed to remain in the hands of experts, who ignore naval requirements and the practical conditions of war, accounts for much misdirected energy and some evident danger." It is therefore well that the question has recently been taken up by a firm who make a continuous study of the necessities of war as an element in the solution of the mechanical problems associated with the manufacture and use of war munitions. We refer to Messrs. Vickers, Limited, whose aim is to meet all "naval requirements and the practical conditions of war." The success of the submarine mine in the Far East compelled them to take up the study of such weapons, and the result has been most interesting. Instead of attacking the problem *ab initio*, they enlisted the services and worked in conjunction with Captain Giovanni Emanuele Elia, formerly of the Italian Navy, who had been devoting his attention to submarine mines since 1890, and had been continuously experimenting with successive inventions, winning a gold medal from the Italian Navy for his scientific work in this connection between 1890 and 1900. His system had been adopted not only in the Italian Navy, but by the Dutch, Belgian, and Roumanian authorities. In association with the well-known firm of Breguet he had done good work in France, and his designs had from time to time been tested by the British naval authorities. Now Messrs. Breguet and Messrs. Vickers have joined forces with Captain Elia.

For the present we are concerned only with the perfecting and testing of that type of mine which is laid in waterways and ocean highways to float near the surface, and so designed that the charge of gunpowder or other explosive is fired automatically when the mine is struck by, or comes into rubbing contact with, a passing ship. Almost every conceivable system of controlling and actuating the striker to fire the percussion fuse has been tested by Captain Elia. It is important to preface the detailed descriptions with a brief enunciation of the essential conditions to be fulfilled. The firing gear must be delicately adjusted in order to ensure explosion of the charge with the slightest shock from the contact of the passing ship, and yet provision must be made so that the mine cannot be fired prematurely either on land or on the mine-laying ship, or when being launched into a "field." The depth of immersion under the surface must be constant, and precisely as predetermined, so far as the rise and fall of tides permit, irrespective of the distance between the water surface and the bed on which the floating mine is to be anchored. A further desideratum is that in the event of one or two mines exploding, the adjacent ones should not be fired; this, it will be recognized, is a difficult condition, as the concussion of the water resulting from the explosion of one mine tends to disturb others as greatly as the contact of a passing ship, and to put a sensitive firing mechanism into action. * * * we illustrate successive steps in Captain Elia's work. Briefly expressed, Figs. 1 and 2 (opposite page 74) show the earlier mine, in which safety in handling is achieved by an ingenious utilization of hydrostatic pressure to "unlock" the firing gear and render it operative, such pressure being available only when the mine is immersed. Figs. 3 to 6 illustrate a mine designed to be laid in pairs, with a connecting cable, so that when a ship fouled the cable and dragged it, the explosive chambers of the two mines would be drawn out of their respective flotation chambers, and pulled alongside the ship. By the resistance of the anchorage medium, it was arranged that the charge would be detonated when the chamber was alongside of the ship's hull. In later mines (Figs. 7 to 10) the pull due to the anchoring device was also made essential to the release of the striker, so that until the anchor had reached the bottom, and until parts of the mine had been deflected from their normal position by the contact of a passing ship, the striker was not free to act upon the percussion-cap of the detonator. But when such locking devices were thus mechanically freed, a strong spring served to actuate the striker and to fire the mine, as will be described later. In the final and most widely-approved system (Fig. 10) a lever external to the mine is utilized for locking the firing-gear. Until the mine is immersed, the locking-gear is sealed with sal-ammoniac; when the seal melts, the lever is free to move. The lever experiences violent shocks when the mine is in contact with, or is spinning along, the hull of the ship. These shocks move the lever sufficiently to unlock the firing mechanism, which is then brought into action by the resistance offered by the anchor to the drag on the mine. Safety is thus ensured until the mine is immersed and comes into contact with a ship, and at the same time immunity from danger from the explosion of adjacent mines is attained by reason of the simplicity of action upon the striker, resulting from the pull from the anchor. The other essential—accuracy and constancy of depth of immersion—has been achieved equally satisfactorily in each of these successive mines, as shall be described later.

---

* Not included herein.

In describing the mines in detail, we begin with the first evolved by Captain Elia in recent years—the single automatic mine—which embodies the hydrostatic plate, the anchoring gear to make the extent of immersion constant, so far as tidal conditions permit, and other features common to mines for various services. This is illustrated in Figs. 1 and 2, * * * Fig. 1 is a sectional view of the flotation-chamber of the mine; to this the anchoring-chamber can be suspended. Fig. 2 is a section of the control and striking mechanism only, the upper part being in a line transverse to the plane of Fig. 1, and with a spiral spring instead of the Belleville spring, shown in Fig. 1. It may be said at once that experience has shown that the latter spring is preferable, as temperature changes affect the spiral spring more than the others.

So far as the general construction of buoyancy and explosive compartments are concerned, nothing need be said. Interest centers in the firing mechanism (shown in Fig. 2). It is contained within a casing which fits into the center of the mine. The ignition of the detonating charge and the main explosive charge is effected through a percussion cap, which is detonated by a striker A, spring-loaded and mounted horizontally. A lock or trigger B retains the striker in the cocked position; but when the mine is immersed this trigger is free, and when the floating body is inclined from the vertical by contact with a ship, the ball C is caused to oscillate in its concave bearing, and the pull then exerted on the chain connecting with the lock withdraws the trigger, and detonation is the result.

For ensuring safety—for preventing premature firing on land or on the mine-laying ship, or before the mine is fully immersed—two safeguards are provided. In the first place, the rolling of the ball is obviated by the frictional resistance of the three-forked clips F, each mounted on one end of the bell-crank lever, having its other end secured to the spindle G, and its center pivoted to the casing. When this spindle is in the raised position the clips grip the ball, and it is normally supported in such raised position by the spring. In the second place, the lock or trigger is in the form of a bell-crank lever D, the arm being under the control of a rod E, which is fitted at its upper end with a piston working in a cylinder, as shown. Prior to submergence the piston is set relatively to the cylinder so that the bottom end of the rod locks the trigger lever and prevents detonation even if the ball C should roll in its cavity. The cylinder of the safety-rod is attached to the hydrostatic diaphragm H supported by the spring, so that the depression of the hydrostatic plate moves the cylinder, and therefore allows the safety-rod and trigger to be moved by the action of the ball C.

Only when the mine has been launched and immersed does the hydrostatic pressure due to immersion exert sufficient downward thrust on the diaphragm to overcome the load of the spring, as well as to force down the cylinder of the rod locking the trigger. To this end the upper compartment is fitted with a flap-valve opening inwards to admit water. The outlet aperture alongside is very small. The diaphragm is fitted to the top of the spindle. When the mine is immersed to a depth of 3 meters the hydrostatic pressure overcomes the load of the spring; the spindle, with its top plate and the safety rod cylinder, is pressed downwards. The clips F are thus freed from the ball C, which may then oscillate by the inclining of the mine owing to contact between it and a ship. This oscillation releases the striker and explosion follows.

A word may be added about the connection of the casing containing the firing gear with the main body of the submarine mine. The upper part, containing the hydrostatic pressure diaphragm, projects above the main body. The connection is made at I in Fig. 2, and is rendered water-tight by the collapsible rings shown.

Trials were made in November, 1910, with the mine illustrated in Fig. 1. It was let loose on the surface of the water, and received the shock of contact with a ship moving at from 5 to 6 knots. As the mine was not immersed there was no hydrostatic pressure upon the diaphragm, so that the spring locked the firing gear, and there could be no detonation. It was found that with the clips gripping the ball, owing to the action of the spring, there was no movement of the ball, although the mine had been inclined at 90 degrees. The same mine was next immersed at a depth of 1 meter from the surface, and was subjected to shocks by contact with ships moving at various speeds. On each occasion the gear acted well.

In his work to devise means for preventing the explosion of one mine from firing adjacent mines, Captain Elia proceeded in consonance with a deduction from experimental tests. Earlier devices intended to prevent such "sympathetic" explosions had been designed on the assumption that such explosion only produced upon the adjacent mine pressure which was uniform on all sides, whereas his tests showed that there was also a shock of percussion which placed the inertia masses in movement; and as this latter depended upon the velocity of detonation and of the gaseous products of decomposition placed in movement, the thrust exerted by the percussion upon the surrounding water took place during a lapse of time with a period determined by the mass of water. Following this first maximum of pressure due to detonation was a second maximum at an interval of one-twentieth of a second, due to the gaseous products during the lapse of time first expanding rapidly and afterwards contracting because of the cooling effect of water, and to their compression and rising to the surface in bubbles owing to their small density relative to the weight of water.

With a velocity of detonation of 6000 to 7000 meters per second, there can be no yielding of the mass of water, and the effect of percussion assumes the appearance of vibrations. The formation of the gases takes place at a velocity equal to that of the detonation, and their volume during the first few movements does not exceed the volume of the explosive itself; in proportion, however, as the water is impelled by the pressure of the gases, this volume is increased. The expansion of the gases occupies a considerable time, as does their cooling and their escape. Between the maximum pressures there is rapid and considerable vibration or wave motion.

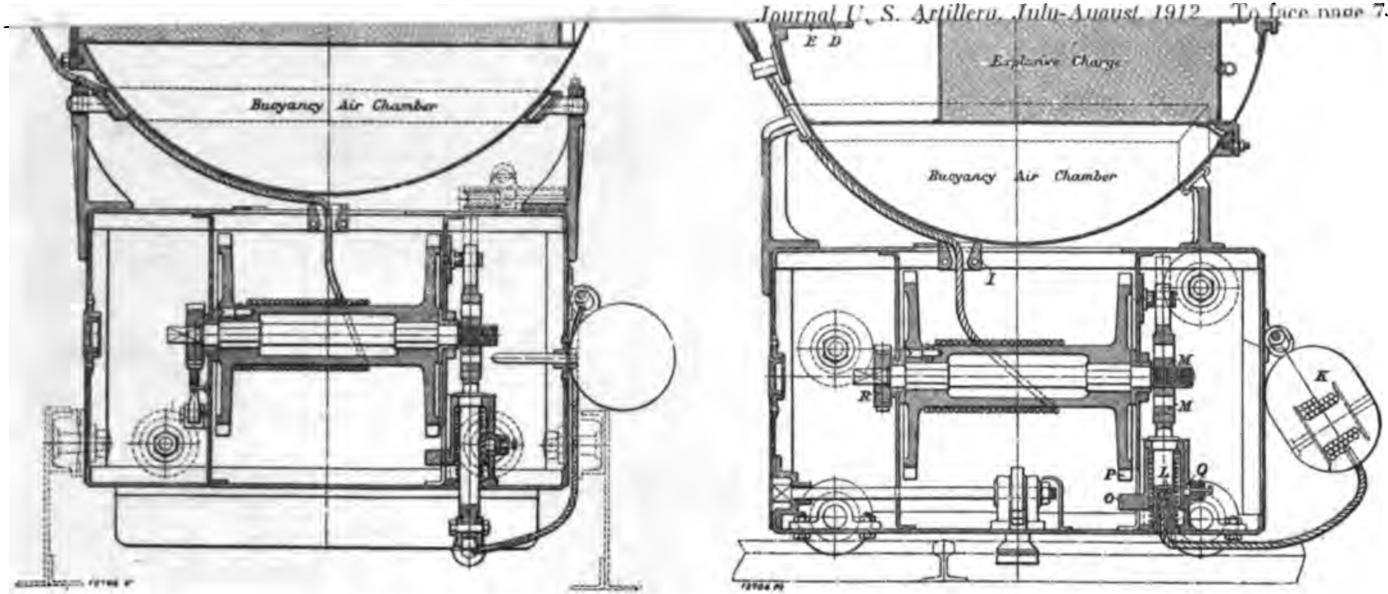
Captain Elia therefore decided to modify his mechanism so that the almost instantaneous action of the first maximum pressure due to the explosion of one mine should be utilized to prevent detonation in all adjacent mines. The super-pressure instantly influences the water in the space where the hydrostatic-pressure diaphragm is placed. The extra pressure on it drives down the spindle G into a cavity on the ball C, the spindle end being convex to fit into the cavity. As the water cannot escape suddenly with any reduction of pressure in the surrounding mass of water, except through the small aperture, the spindle remains locked in the ball throughout the period between the two maxima of pressure; and for a sufficient period after the second maximum the ball is prevented from oscillating even should the mine continue to roll with the resultant wave-motion of the water. Consequently the action of an explosion itself puts out of action the firing gear of all adjacent mines until such action is dissipated.

To mine effectively a given area of waterway, in order to ensure that all vessels, including those of comparatively small beam, should foul one or other of the mines, a great number of submerged mines would require to be placed at small distances apart; otherwise small ships might adventitiously evade contact with every mine. To meet this economic condition, Captain Elia and Messrs. Vickers, Limited, have evolved a system of twin mines, each pair being connected by cable, the specific gravity of which is such that it will normally remain taut between the mines at a depth corresponding to the degree of their immersion. The intention is that a vessel proceeding through a mine-field should foul this rope, drag it, and consequently the twin mines until they came alongside the ship, the drag ultimately involving explosion. A considerable modification in the design of the firing mechanism was necessary, as otherwise the drag upon the mines would have inclined them, set the ball oscillating, and caused the instant explosion of the mine when the cable was first dragged by the ship, with the ersult that, because of the distance of the mines then from the vessel, their destructive power would have been reduced.

The new design of mine (Figs. 3 to 6, * * * is arranged in three parts:—(1) The upper central part containing the firing mechanism, the detonator, and explosive danger; (2) the outer part of flotation-chamber; and (3) a detachable anchoring-chamber with a winch having a paying-out cable. When the connecting cable is dragged by a ship the upper central part (1) is withdrawn from the outer part (2) of the flotation-chamber. It is arranged so that an appreciable period of time elapses between the contact of the ship with the connecting cable before the explosion takes place; thus, owing to the prolonged drag the explosive-chamber (1) is drawn close to the ship, while the anchoring device (3) prevents the explosive-chamber, which is also a buoyancy-chamber, from rising to the surface. The result is that ultimately the explosive-chamber glides along the side of the ship to lie against it at a considerable distance under the water-line. Various means are adopted for releasing the striker for firing the mine, so that detonation takes place when the mine is alongside the under-water structure without armor protection, and therefore suitably located to cause the maximum of destruction to the submerged part of the hull.

The drawings, Figs. 3 to 6, * * * illustrate the mechanism. Fig. 3 is a part elevation and part section, the latter showing the lower part or anchoring-chamber, with a paying-out drum. Fig. 4 is the section of a mine transverse to the plane of Fig. 3. Fig. 5 is a plan showing the connection of the connecting cable at the top. Fig. 6 shows in detail the firing apparatus. It will be seen from Fig. 4 that the casing containing the bursting charge is conical, to fit into a cavity formed in the flotation-chamber, which is only the buoyancy chamber. The conical drum also contains a buoyancy-air chamber, as well as a compartment for the gunpowder or explosive charge. In the center compartment there is the firing-gear, as shown in detail in Fig. 6, the upper part being packed with wood, with a double-hinged cover. Deferring for the present the description of the firing-gear until we come to the method of operation, we may now refer to the method of anchoring the mine in position.

The anchoring system is similar generally to that adopted with the automatic mines, and may be dealt with here as it is shown in Figs. 3 and 4. The system, it will be recognized, fully realizes one of the essential features of such war apparatus already enunciated. Captain Elia began, in 1888, study of anchorage to ensure a uniform and constant degree of immersion, as tidal influence would permit, and the first system was then built at nderia del Pignone, Florence, Italy. Since then such anchorage has feature of all his mines.



Engineering.

1141

ELIA'S AUTOMATIC SUBMARINE MINES (VICKERS-BREGUET SYSTEM)

The anchor is a chamber, within which is a paying-out drum, one end of the cable being connected to the bottom of the flotation-chamber; while suspended from the anchor-chamber is a sounding-line, with a plumb-weight in the form of a ring, as in Fig. 3. This sounding-line is free to drop 3 meters only, and then it actuates levers controlling the paying-out drum. When the mine has been floated the weight sinks 3 meters, and then exerts a pull immediately on the lever A, which releases a pawl on a rachet-wheel on the paying-out drum, as shown in Figs. 3 and 4, while the larger ring actuates the rods B, which disconnect the anchoring from the flotation-chamber. When this disconnecting operation begins the relation of the weight on the

Fig. 11.

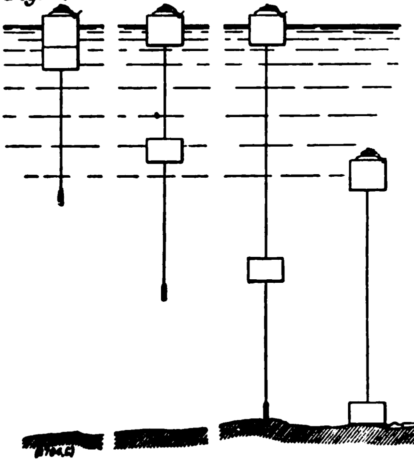
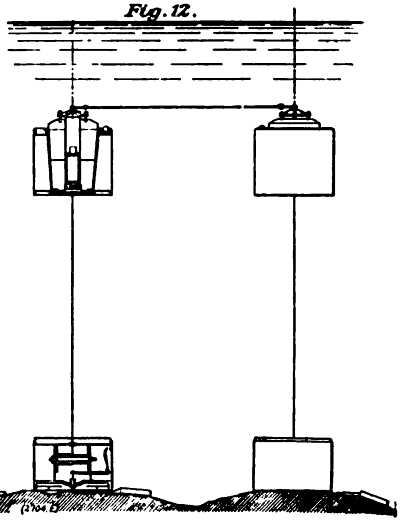


Fig. 12.



1142

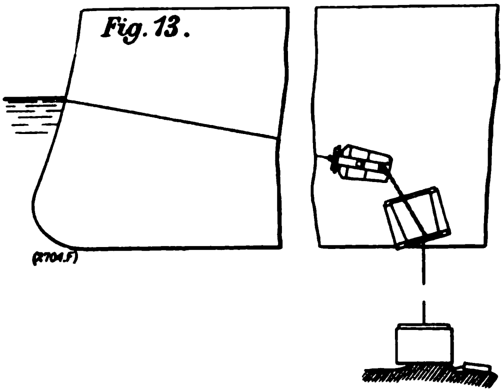


Fig. 13.

1143

sounding-line to the mine is as in the first position in Fig. 11, on page 75; the anchoring-chamber, as well as the plumb-weight, sink in the same relative position as in the second position in Fig. 11. When, as in the third position, the weight touches the bottom of the sea, the pull upon the lever A ceases and its pawl enters the ratchet-wheel on the drum, which ceases to pay out. The anchor-chamber, however, continues to sink, and the flotation-chamber is drawn down with it and immersed at a depth from the surface of 3 meters, as in the fourth position (Fig. 11), since this was the distance which separated the weight of the sounding-line and the anchor-chamber and the distance from the bottom of the latter when its paying-out drum ceased to revolve aud began to draw the flotation-chamber from the surface.

When the mine is first launched the conical drum is fitted in the flotation-chamber, and is secured by shearing-pins, C, in Fig. 4, the pull by the ship in contact with the cable connecting the twin mines being sufficient to shear the pins, and thus release the drum. The connecting cable passes round the buckle E in Figs. 4 and 5, and engages with a pin actuated by a spring, and kept in position before immersion by means of a double plug of sal-ammoniac, F, in Fig. 3. When the cable is submerged to the required depth, the sal-ammoniac dissolves, releases the pin, and the cable is then free to act upon the conical drum, and also the firing gear, when it is dragged by a ship. The position then is as shown in Fig. 12, on page 75. The distance apart of the mines is, of course, determined by the probable dimensions of the ships using the waterway.

When a ship comes into contact with the connecting cable a drag is exerted upon the conical drum within each flotation-chamber. This pull, being counteracted by the anchorage, causes the pins C connecting the drum to the chamber to be sheared, and the conical drum is drawn from the flotation-chamber. The forward movement of the ship tends to bring each drum, with the connected lines, alongside of the ship, as shown in Fig. 13, on page 75. The drum, which contains the explosive charge, is, however, secured by a chain connecting it (Figs. 4 and 6) to a shackle in the bottom of the flotation-chamber, to which also is attached the cable from the winding-drum in the anchor-chamber. The cable is thus directly connected with the striker G, forming part of the firing gear, so that the continued drag by the ship is directly responsible for the firing of the mine.

This firing gear, Fig. 6, consists of a striker actuated by a spring connected to the cable on the drum in the anchor-chamber, through a chain, as shown in Fig. 4; but this connection is made through a shearing-pin H, proportioned to shear when subjected to a pull of 400 pounds. At the other end of the spindle near to the striker there is another pin I, proportioned to shear under a pull of 200 pounds. The continued pull of the ship on the conical drum after it has left the flotation-chamber draws the drum, with the detonator, away from the striker, by reason of the resistance or contrary pull upon the striker owing to its connection through the spindle and chain with the anchor. As the pull continues the shearing pin I gives way. The rebound of the spring drives the striker suddenly against the detonator, which sets in action the spiral time-fuse K, whose action ultimately works upon the main detonator and explodes the mines. By the introduction of the time-fuse the period between the contact of the ship with the connecting cable may be varied, in order to ensure that the explosion may take place when the conical drum and the explosion-chamber are in the most advantageous position, preferably in the mid-distance between bow and stern, and well under the water-line. But the whole action of the twin mine may be comprised within a very short period; indeed, it is probable that, under certain conditions, there will be no need for the introduction of a time-fuse, as the sequence of action of the release of the conical drum, the resistance of the winch within the anchor-chamber, and the shearing of the pin I, might meet the condition without any need for the interposition of a time-fuse.

Fig. 14.

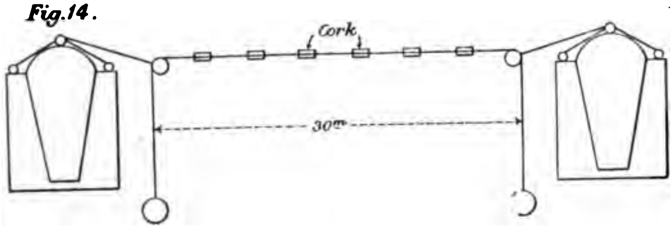
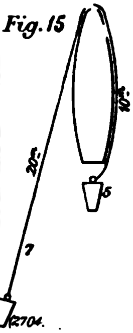


Fig. 15



1144

Fig. 16.

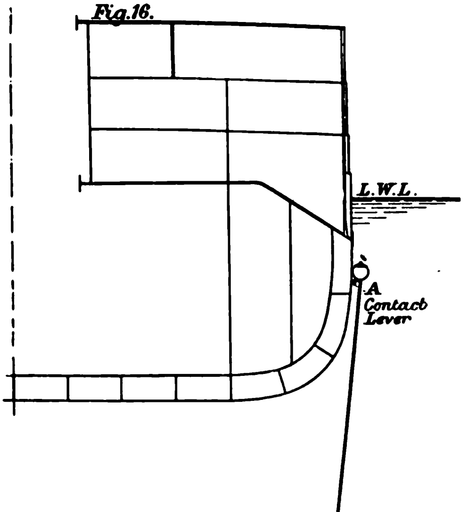
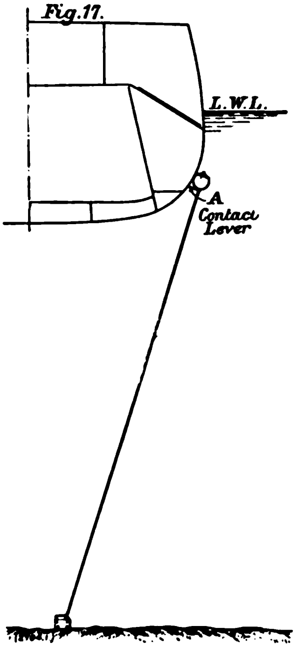


Fig. 17.



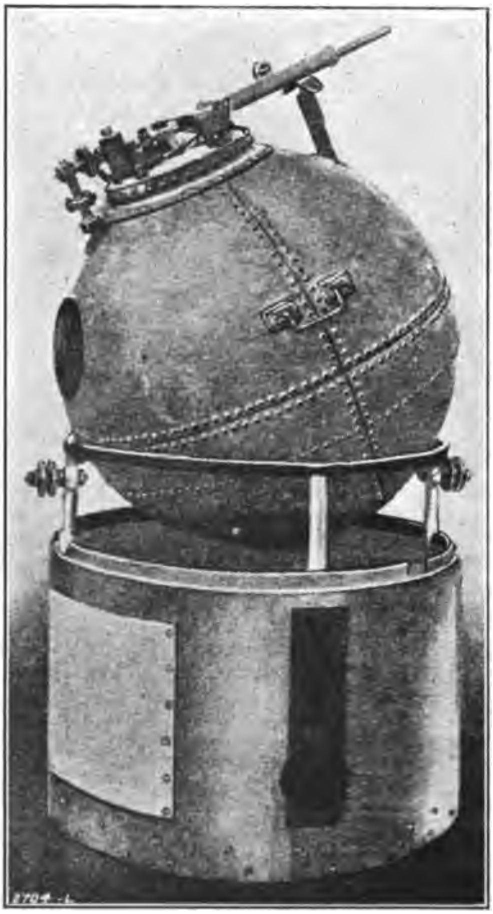
1145

Trials have been made with such twin mines. In one a pontoon was used, and was towed by a steam-launch. For this trial the twin mines were moored in water having a depth of 10 meters, the immersion of the flotation-chamber from the surface being 1 meter. For the purpose of the trials, as shown in Fig. 14, on page 77, the two mines were connected by a cable, about 30 meters long, running at each end through a pulley coupled to the respective mines, while the cable was supported on cork floats and kept taut by a weight of 10 kilogrammes at each extremity. The tops of the two mines were connected to the pulleys by means of lanyards, and the whole of the gear was arranged so that the conical drums would be dragged from the flotation-chambers when a pull of 200 kg. was exerted by the towed pontoon. The speed at which the pontoon was moved was from 5 to 6 knots, and its effect upon the cable is shown in Fig. 15, on page 77. Both conical chambers were, of course, withdrawn from the flotation-chambers. One got into the race of the screw propeller of the steam-launch, and the cable fouled the propeller, so that it was immediately stopped. When the two mines were recovered and examined, it was found that the detonators of both had been fired, so that not only would the screw-tug have been destroyed by their explosive charge, but so also would have been the pontoon.

During 1911 other trials were carried out, and in this case the conical drums were dragged close to the hull of the ship without any indication of their presence being disclosed by surface movement, while the connecting cable remained well under the water-line.

Experience with the single automatic mine, in which the principle of the hydrostatic plate or diaphragm was utilized for rendering the firing mechanism operative, demonstrated that the principle entailed inherent difficulties, which had more or less been anticipated under certain conditions. The system proved thoroughly satisfactory where there was a small range of tide, notably in the Mediterranean. Once the mine was anchored, the variation in the tide level did not greatly affect the hydrostatic pressure available to overcome the spring actuating the locking gear. Where, however, the tidal range was great, the mine had to be submerged at a depth to give the desired hydrostatic pressure at low-water level of spring tides. The position of immersion might therefore have been too deep to ensure contact with lighter draught ships, which might thus pass over the mine-field with impunity. On the other hand, unless the mine were submerged to a given depth the hydrostatic pressure would be insufficient to counteract the safety spring and make the firing gear operative. Again, it was found during trials that a difference of 20 degrees C. in the temperature of the atmosphere, of 22 mm. in barometric pressure, or of 4 mm. in humidity, involved a difference in hydrostatic pressure equal to an immersion of the mine to the extent of 2½ meters. Thus, where there were such ranges in atmospheric conditions it was difficult to ensure, at the normal depth of immersion, that the hydrostatic pressure would be sufficient. Captain Elia made many experiments, with a view to overcoming these inherent difficulties. His aim was to combine a safety gear with certainty of action when the mine was subjected to shock by contact with a ship. A scheme at which he worked for a considerable time included the trial of a hydrostatic plate enclosed in a watertight box, which could only be opened to allow the water to act on the safety gear at the moment of contact with the ship. The system, however, was complicated, and did not render the mine as safe as was essential during handling, because the lever regulating the introduction of water was apt to be broken.

There was one further objection to the single automatic hydrostatic-pressure mine. Where the trigger was released by the oscillation of a ball, due to contact with the ship, it was possible to conceive, and, indeed, it was demonstrated on some trials, that contact between the ship and the mine might not create a shock, but rather cause the mine to spin along the side of the ship without involving the heeling of the mine to a sufficient angle from the vertical to cause the ball to move far enough from its central position to withdraw the locking-pin in the striker in order to fire the mine.



Engineering 1146

FIG. 18.

These trials and observations led Captain Elia to an important modification in the mechanism for actuating the firing gear. The later system is purely mechanical, and, moreover, obviates any possibility of either the shock or the wave-motion set up by the explosion of one mine affecting others. This mine is globular in form, and is fitted with a lever which projects beyond the mine and is deflected angularly from its set position when the mine comes in contact with the ship and rolls along the side of the hull. The action of this contact-lever will be seen clearly from the sketches, Figs. 16 and 17, on page 77.

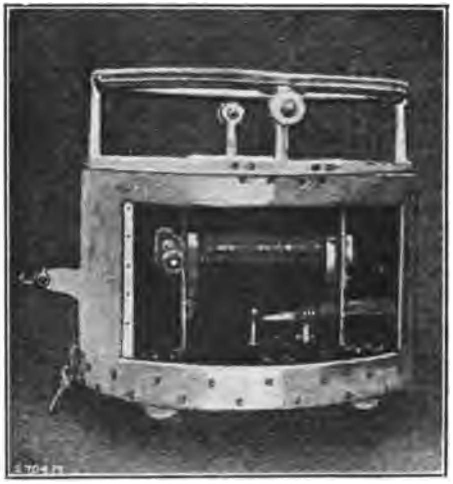
The first application of the principle of the contact-lever, which is known as design No. 6, is shown in Figs. 7 and 8, * * * and in perspective in Figs. 18 to 20, pages 79, 81 and 83. The method of supporting the lever is shown in Fig. 8, from which it will be seen that the lever is locked by a spring-supported spindle, so that the shock must be one of considerable force. A submerged log, for instance, would not be sufficient to displace the lever from its locked position. The lever and its mechanism is placed on the top of the spherical mine. On it there is a stop A, so that only when it is forced laterally through a certain arc by contact with the ship can the locking-pin B be free to recede into its groove, a receding action which is ensured by the spring C. When this locking-pin recedes, the striker D, by reason of the loaded spring behind it, fires the mine through the percussion-cap E, the flame being transmitted to the detonator.

There have been introduced two means of ensuring safety while the mine is being handled, and until it has been sunk to the predetermined depth below the surface. The first of these consists of a forked stop I, arresting the action of the contact-lever. This stop is only withdrawn by the pull of the anchoring cable overcoming the resistance of the spring H, so that until the full pull of the anchoring cable is exerted the forked stop cannot move. Even so, there is the sal-ammoniac seal M, which secures the extension-rod of the lever in its retracted position engaged with the cavity N, thus definitely locking the lever to the frame of the firing-gear. When the sal-ammoniac is dissolved the rod is forced outward by its spring clear of the notch N, and the firing-lever is free to rotate. The second device for preventing the action of the lever, unless the shock of contact is considerable, consists of a spring-loaded brake P. The perspective view, Fig. 18, shows the mine with its anchoring-chamber ready to be lowered. Fig. 19 * * * shows the anchoring-chamber itself with the cable-winch, while Fig. 20 illustrates the method of lowering the mine from a barge by means of tripods. This anchoring gear, however, will be described later, when we have dealt with the improvements made in the firing device.

The next design, known as No. 5, is illustrated in Fig. 9. Here the contact-lever is placed on the bottom of the mine. Percussion in this case is achieved by the direct pull of the mine on the anchoring-cable. This pull would naturally be increased as a result of contact between the mine and the ship; but until the contact-lever has moved angularly through a certain arc, and the projection B has cleared the end of the striking mechanism, percussion cannot take place. As the firing gear is unlocked a direct pull is exerted on the spindle by the buoyancy of the mine. It will be seen that at C there is a forked crosshead, each arm terminating in a bulb to fit into a neck on the striker spindle A. As the forked crosshead is drawn outwards, its ends drop into the enlarged part D, releasing the trigger spindle A, which, impelled by its spring, rebounds against the detonator. At E there is introduced an elastic rubber joint in order to make the firing gear completely water-proof. The contact lever prevents detonation until it is struck by a passing ship. There is the further provision that this lever cannot operate until the sal-ammoniac seal is melted, as in the design No. 6. At the same time there is a transverse rod G at the top of the mine which locks the firing gear until a sal-ammoniac plug has dissolved, when a spring forces the rod out of engagement with the firing gear.

As a result of the trials of the designs No. 5 and No. 6, it was decided to combine the best features of the two types, and the resulting design is shown in the section, Fig. 10, * * * and in perspective in Figs. 21 to 23. In this case the pull on the anchor-cable is utilized for effecting detonation, but the form of the stuffing-box, with the elastic joint E, is slightly modified. In this case the detonator can be inserted at the last moment from an opening at the top. The perspecitve views show generally the construction. In Fig. 21 the contact-lever is in the safety position, whereas in Fig. 22 it is in the firing position.

Many trials have been carried out with these mines. The particular mine of No. 6 design tried had a total weight of 124 kg., designed for a charge of 80 kg., while the buoyancy was 120 kg., and the midship section 60 square decimeters. In the case of No. 5 design, the floating chamber weighed 51 kg., the anchor 250 kg.; while the charge was equal to 20 kg., the buoyancy was 51 kg., and the midship section 33 square decimeters.



Engineering 1147

Fig. 19.

On October 27, 1910, mines corresponding to designs Nos. 5 and 6 were immersed to the required depth by the assistance of a pulley secured to a buoy rope. A 40-ton vessel, 25 meters long, moved past the buoy at a speed of 5 knots, the mine rolling several times round its axis along the hull. Subsequently it was found on examination that the detonator had fired in the case of both designs. A mine of No. 5 design was tried on April 13, 1911, being immersed 20 cm. below the surface. A steamer of 50 tons passed at a speed of 1 knot, and detonation took place successfully. At the same time a mine of design No. 6, immersed 40 cm., was passed by the same steamer at the same speed, and on subsequent examination the detonator was found to have acted. A mine of No. 6 design, immersed to the extent of 30 cm. below the surface, was passed by the same vessel steaming at 1 knot, and it was found on subsequent examination that the detonator had fired. On November 6, 1911, a tug-boat of 60 tons steamed past the mine of No. 5 design, which was immersed to the extent of 20 cm. below the surface. The speed of traverse of successive trials was 1 knot, 2 knots, and 3 knots, and the detonator was fired in each case. On the same date a mine of No. 6 design was tried, first with a vessel going 2½ knots, while the mine was submerged 40 cm.; next with the vessel going 1 knot, and with the mine submerged 10 cm.; and finally with the vessel going 4 knots, the mine being immersed to the same extent. In all cases there was successful detonation.

We have already described the method adopted for anchoring the single automatic and the twin mines, and may now direct attention to the details for ensuring in the case of these spherical mines the same result—namely, precision, so far as tidal influence permits, in the depth of immersion, irrespective of the total depth of water in the mine-field. The principle is the same, and the details are well shown in Fig. 10, * * * while the perspective view, Fig. 21, page 85, shows also the anchoring-chamber and its winch, with paying-out cable. Fig. 22, on the same page, shows the exterior, and in Fig. 23 there are seen the weight and the sounding-line suspended to the anchoring-chamber. The paying-out cable is connected to the end of the spindle actuating the firing gear, and passes through a cursor I (Fig. 10) on to the drum of the winch. The cursor is of soft metal, being easily removable, while the cable is of steel, so that there is no excessive wear of the cable.

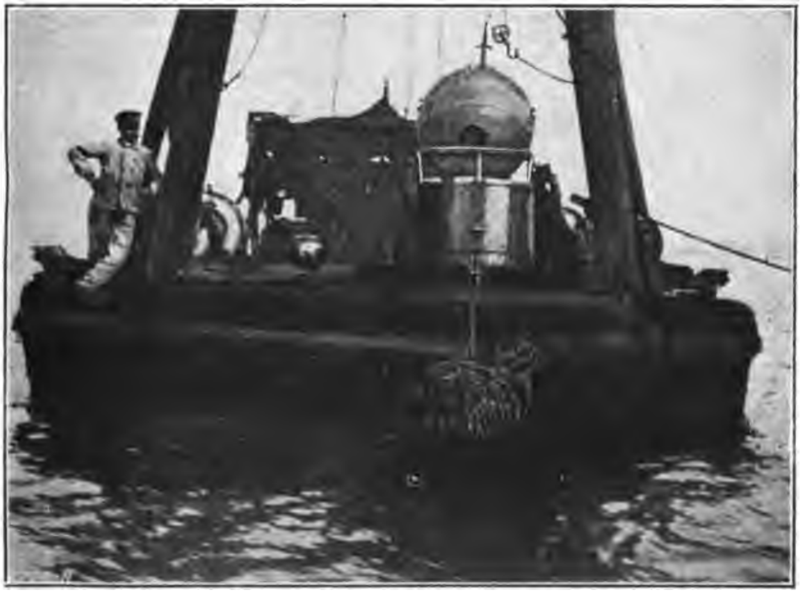
The section, Fig. 10, shows the mine complete in transit on a bogie on rails. The projection at the bottom is simply a brake, in connection with the transit arrangement. When launched the weight K is detached, and drops for the whole length of the sounding-line, which is fixed in any particular mine at the depth at which the mine itself is to be immersed under the water surface. This weight, which acts as a plumb line, is, as seen, supported on a spring-loaded spindle fixed in a cavity of the anchoring-chamber, in order that, when the weight touches bottom and the tension of the spring is released, the spindle, actuated by the spring, may drive a pawl into the pinion of the paying-out drum. As soon as the mine is floated the cable begins to pay out, the anchorage-chamber sinking.

At the end of the shaft of the paying-out winch there is formed a threaded extension, mounted on which is a square nut M, which, under normal circumstances, bears against the spindle carrying the pawl for engagement with the toothed pinion of the winch. Ultimately this nut clears the spindle, but so long as the weight is acting on the spindle it cannot rise in the guide. As soon as the weight touches bottom, and the pull upon the spindle ceases, the spring forces the spindle through the groove up the guide until the pawl O enters into one of the teeth in the wheel P, arresting the motion of the paying-out winch. At the same time, the spring-loaded stop Q advances into the spindle cavity, retains the spindle in the highest position of its vertical travel, and thus permanently clamps the geared wheel on the winch. The action of this apparatus is thus positive, and definitely and permanently stops the winch. In this way it is rendered impossible for the winch to rotate in any way, so that even strong currents have no effect upon the degree of immersion of the flotation-chamber of the mine.

From what we have already written, it will be understood that as the winch ceases to pay out when the weight of the sounding-line has reached the bottom, and as the weight of the winch drags the flotation-chamber downwards with it, the final mooring position of the flotation-chamber will be at a distance from the surface equal to the length between the anchoring-chamber and the weight on the sounding-line.

Exhaustive trials have been made of this anchoring system to determine the accuracy in the depth of immersion of mines designed on this principle. Four mines were used for this series of tests, and the results are given in Table I, page 84. In each case there was brought into operation a brake mounted on the shaft of the paying-out cable at R, and the strength of this brake, which regulates the speed of the sinking of the anchor, varied from 2 kg. to 7 kg. The mines were lowered from the deck of a ship, as shown in Fig. 20, and the sounding-weight was dropped into the sea at the same time.

The first column shows the date, the second the number of the particular mine used, the third the depth of the sea, while the fourth and fifth give respectively the depth of immersion desired and that actually obtained. It will be seen that in no case did the degree of immersion obtained exceed 20 per cent. of that desired. It will be noted, too, that in the case of immersion of 3 meters the result was in the worst case only 6.66 per cent. in excess of that aimed at; with 1 meter immersion the excess ranged up to 20 per cent.; with 5 meters immersion, 6 per cent.; and with 8 meters immersion, under 4 per cent.



Engineering 1148

FIG. 20.

The speed of sinking was tested in several trials in a depth of water of 72 to 75 meters. The predetermined depth of immersion was 5 feet in water of a depth of 75 meters, and the time taken to anchor was 32 seconds, giving a speed of about 2.3 meters per second. With a depth of 72 meters the time taken was 28 seconds, giving a speed of practically 2½ meters per second.

TABLE I.

Tests of Accuracy in Depth of Immersion of Mines No. 6 and No. 5 Design (Figs. 14 to 23.)

Date	Mines	Depth of Sea	Immersion.	
			Desired	Obtained
		meters	meters	meters
18/7/11, Morning	4	16	3	3.10
	2	16	3	3.20
	1	16	3	3.00
	3	16	3	3.10
18/7/11, Afternoon	4	16	3	3.05
	1	16	3	3.00
	3	16	3	3.15
19/7/11, Morning	2	6	1	1.00
	1	6	1	1.15
	3	6	1	1.00
	4	6	1	1.10
19/7/11, Evening	3	6	1	1.00
	2	6	1	1.15
	4	6	1	1.15
	1	6	1	1.20
25/7/11, Morning	2	16	8	8.20
	1	16	8	8.05
	4	16	8	8.00
	3	16	8	8.00
26/7/11	2	16	8	8.05
	1	16	8	8.30
	3	16	8	8.05
	4	16	8	8.15
27/7/11	3	80	5	4.90
	2	77	5	5.30

In the case of a mine of design No. 5, a test was made to determine the maintenance over a prolonged period of the depth of immersion. The depth of water was 10 meters, and the depth of immersion was decided upon as 1 meter. After six hours it was found that there was no change in the depth of immersion, allowance being made for the rise of the tide. Upon the mine being dismantled it was found that there was no leakage into the firing mechanism. The mine designed on the lines of No. 6 was similarly immersed for 23 hours, at a depth of 9 meters from the surface, and here also absolute water-tigthness was thoroughly established upon dismantling and examination of the interior.

(To be continued.)

—*Engineering*, April 20, 1912.

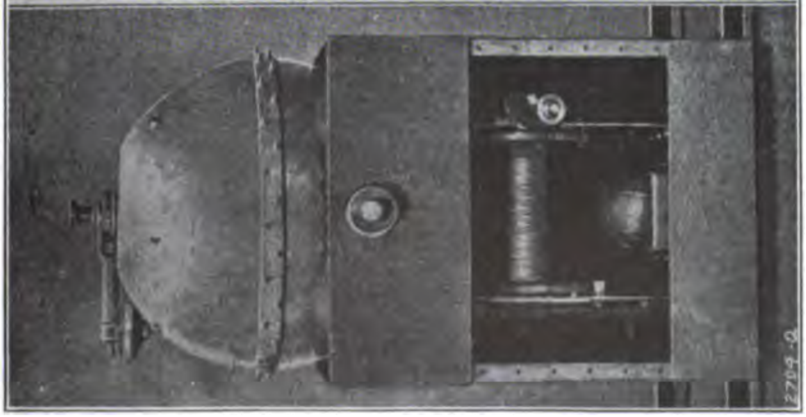


FIG. 21.

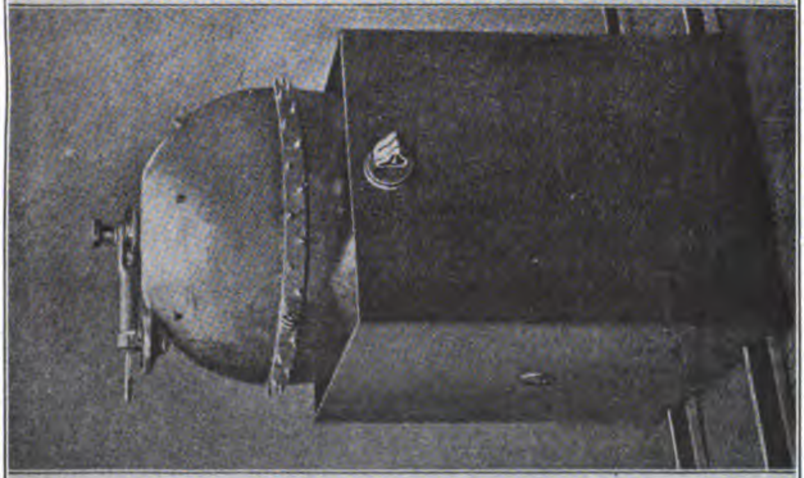


FIG. 22.

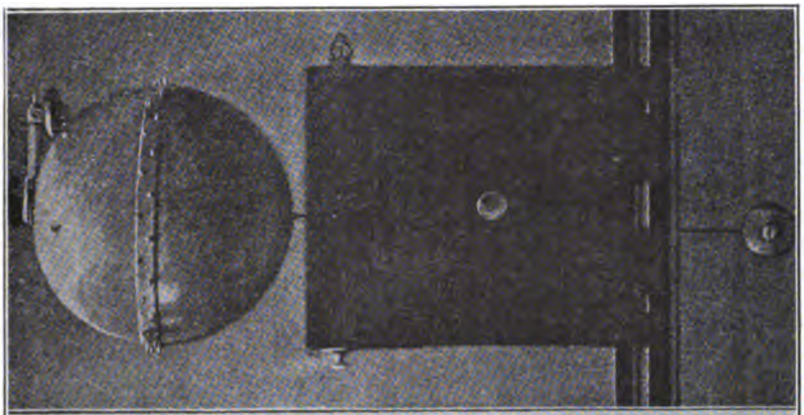
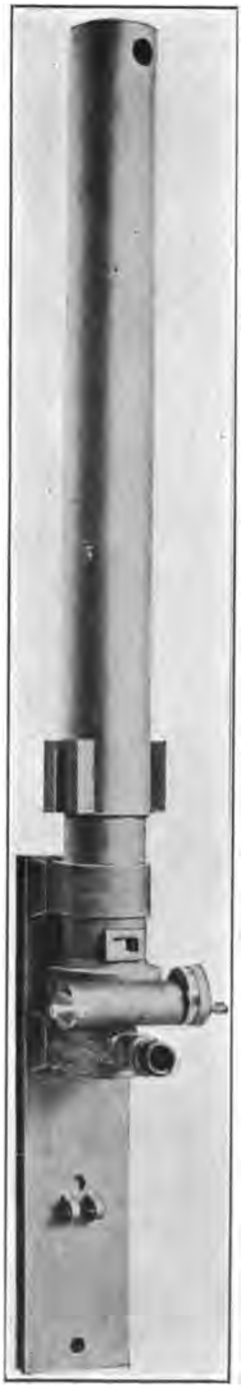


FIG. 23.

Engineering 1149



1150

THE GOERZ PERISCOPE FOR TORPEDO-BATTERIES AND SUBMARINE MINES

The instrument is stationed behind the rampart and allows the observation of hostile ships approaching torpedo-batteries and submarine-mines, without the observer being seen himself.

At the bottom of the instrument is an azimuth circle graduated into degrees,—the minute divisions can be read on the micrometer wheel. It can be oriented as desired,—with the torpedo-aiming-apparatus for example, and serves to fix the moment of firing.

The observer keeps his seat and moves only the object-glass. The zero-line of the instrument corresponds with the axis of the torpedo-tube.

Two or three different magnifications may be given to the periscope.

This instrument would be useful also as a horizontal base instrument at a battery,—no special station being required, since it can be bolted to the rear face of the rampart.

◆ ◆ ◆

THE JUBILEE OF THE TURRET SHIP

IN ITS ESSENTIALS THE TURRET HAS CHANGED VERY LITTLE IN THE FIFTY YEARS OF ITS LIFE

By Percival A. Hislam

On August 3rd, 1861, the Federal Government voted supplies for the construction of coast-service ironclads and four days later an advertisement was issued from Washington inviting competitive designs. Among those who submitted proposals was John Ericsson, and on October 4th a contract was signed by which he was intrusted with the construction of the ship which was to become famous as the *Monitor.* The keel-plate of this vessel was laid at Brooklyn on October 25th, 1861; on January 30th, 1862, she was launched; and fifty years ago she was completed for sea on February 15th, 118 days from the laying of the first keel-plate.

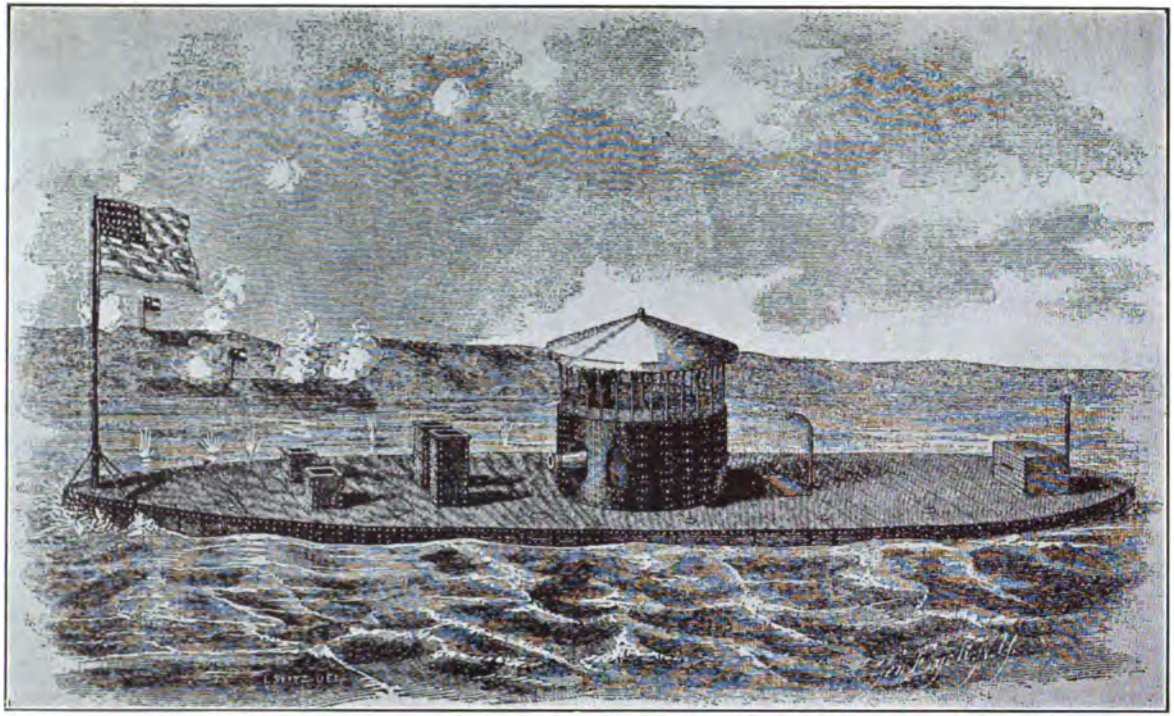
It is customary to regard the *Monitor* as the first turret ship ever built, but as a matter of fact this distinction belongs to the Danish gunboat *Rolf Krake,* which was laid down a few months before the *Monitor.* However, the latter is by far the better known of the two, and she was the first vessel in which the new method of mounting guns was thoroughly and successfully tested. It is, perhaps, not generally known that Ericsson submitted the design of a vessel similar to the *Monitor* to the Emperor Napoleon at the time of the Russian war of 1854, and that the Emperor passed over the suggestion in favor of armored batteries. Capt. Cowper Coles, an English naval architect who was responsible for the design of the British turret-ship *Captain*, which capsized in the Bay of Biscay in 1870, had also suggested the turret system of gun-mounting in 1860, but his suggestions differed considerably from those embodied in the *Monitor* by Ericsson the following year.

The general appearance of this really epoch-making vessel is too well known to need lengthy description here. In many pictures, however, she is quite improperly represented as having no protuberances above the deck except the turret and the smoke-stack, the conning-tower (or pilot-house, as it was then called) being shown on the roof of the turret. This was, indeed, Ericsson's original idea, and it was adopted in later vessels of the type; but in the case of the *Monitor* he had no time to make the necessary arrangements, and the conning-tower was mounted well forward. A speaking-tube connected this with the turret, but it will be recalled that in the famous duel with the *Merrimac* this was severed early in the engagement, and communication had afterward to be kept up by a chain of men. Further, the *Monitor* had two smokestacks, not one. These were square, and abreast, and were capable of being stowed away when going into action. There were also two blow-hole shafts abaft the funnels.

It is rather curious to reflect that the turret-ship was heralded as the type which was to replace the so-called "broadside ship." The type of which the *Monitor* was the pattern did, indeed, replace the earlier pattern; but the strange thing is that this earlier pattern—which was partially resuscitated later—should have gone under the name of "broadside ships" at all. To all intents and purposes they were simply developments of the old frigates and three-deckers—that is to say, the broadside fire never exceeded to any considerable degree fifty per cent. of the total armament. The *Monitor*, of course, could fire both her guns on either broadside; and had there been time for Ericsson to erect the pilot house on top of the turret, they would have had an effective arc of 360 degrees when the funnels were unshipped.

The original turret ships of the *Monitor* type were designed primarily for coastal service, and although many of them made long voyages—the *Miantonomoh* crossed the Atlantic in 10 days 18 hours, and the *Monadnock* made the journey round the Cape—this was really all they were suited for. Direct developments from Ericsson's ship continued to be built for the American Navy until the beginning of this century. The *Arkansas*, *Nevada*, *Florida* and *Wyoming* (now the *Ozark*, *Tonopah*, *Talahassee*, and *Cheyenne*, respectively), completed in 1902-3, are still usually classed as "coast defense monitors;" and although they are as superior to the vessel of 1862 as forty years of scientific advance could make them, they are nevertheless considerably inferior from the point of view of the fact that the superstructure aft cuts a large arc out of the angle of fire.

It is not only in coast-defense ships, however, that the influence of Ericsson's turret ship is to be traced—if that were the case it might reasonably be said to have died a natural death a decade ago. On the contrary, the most modern of the world's warships illustrate the immutability of the principles to which Ericsson gave expression, and the more recent the ship the more

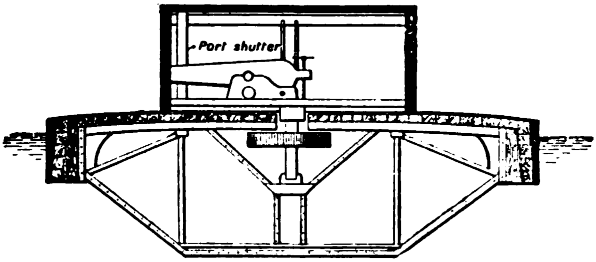


Scientific American 1151

ERICSSON'S MONITOR OF 1862

This engraving, first published in our (*Scientific American*) issue of March 22, 1862, was drawn by the *Scientific American* artist at the Brooklyn navy yard, just before the "Monitor" sailed for Hampton Roads. Naval authorities consider it one of the most accurate representations ever published closely are those principles followed. The only really essential difference is that all modern armored ships are built forsea-going work, and therefore have high freeboards.

The main features of the *Monitor* design were, the heaviest possible gun, an all-round fire, efficient armor protection, and a small target. As the *Monitor* was built to fight at very short ranges, the freeboard of the guns was of no consequence; to-day, when battle ranges promise to average in the neighborhood of 10,000 yards, it is policy to raise the guns to as high a level as is compatible with stability, power to hit being of more importance than the power to avoid being hit, save in so far as immunity from damage is to be insured by damaging the enemy first.

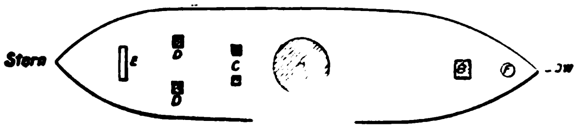


1152

Cross Section of the Monitor

The arrangement of the armor and backing

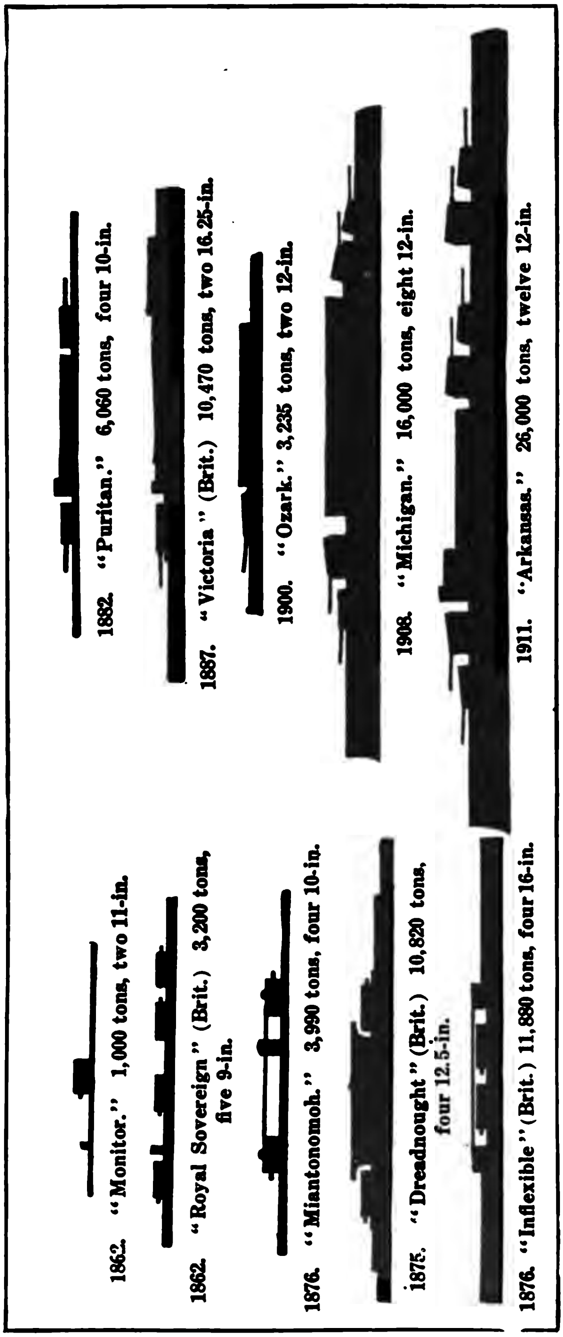
Several Powers followed in Ericsson's footsteps by building turret ships of various patterns, and within a couple of years there had been set afloat two vessels which were a closer approach to the modern dreadnought than anything built between 1865 and 1905. These were the American *Roanoke* and the British *Royal Sovereign*, described and illustrated in the *Scientific American* for November 29th, 1909, and February 19th, 1910, respectively. The former was given three and the latter four center-line turrets. In the British navy an attempt was made later to combine the turret system with full sea-going and sea-keeping qualities, but it was not altogether successful. The largest turret-ship ever built was the British *Inflexible*, of 11,880 tons. This ship was launched in 1876, and carried four 16-inch 80-ton muzzle-



1153

Deck Plan of the Monitor

A. Turret. B. Pilot House. C. Smokestacks. D, D. Blower shafts. E. Propeller well. F. Anchor well


1862. "Monitor." 1,000 tons, two 11-in.
1882. "Puritan." 6,060 tons, four 10-in.
1862. "Royal Sovereign" (Brit.) 3,200 tons, five 9-in.
1887. "Victoria" (Brit.) 10,470 tons, two 16.25-in.
1876. "Miantonomoh." 3,990 tons, four 10-in.
1900. "Ozark." 3,235 tons, two 12-in.
1875. "Dreadnought" (Brit.) 10,820 tons, four 12.5-in.
1908. "Michigan." 16,000 tons, eight 12-in.
1876. "Inflexible" (Brit.) 11,880 tons, four 16-in.
1911. "Arkansas." 26,000 tons, twelve 12-in.

Scientific American

1154

THE TURRET SHIP FROM THE MONITOR OF 1862 TO THE ARKANSAS OF 1911 loaders in two echeloned turrets. The heaviest gun ever mounted in a turret on shipboard was the 16.25-inch 110-ton gun. Two of these weapons were mounted in a single turret forward in the British battleships *Sans Pareil* and *Victoria*, launched in 1887. Weapons of greater caliber (17.7 inches) but less weight were mounted in the old Italian battleships *Dandolo* and *Duilio*. One of the most remarkable turret-ships ever built—also British—was the coast service vessel *Hotspur*, launched in 1870. It had frequently been urged that the revolving turret was liable to be put out of action by a shot damaging the turning mechanism or throwing the turntable out of truth. The *Hotspur* was, therefore, equipped with a fixed turret pierced with four large port-holes through which the single gun could be projected as required. Needless to say, it was not long before the authorities discovered the futility of this arrangement, and the fixed structure was then replaced by a revolving turret with two guns.

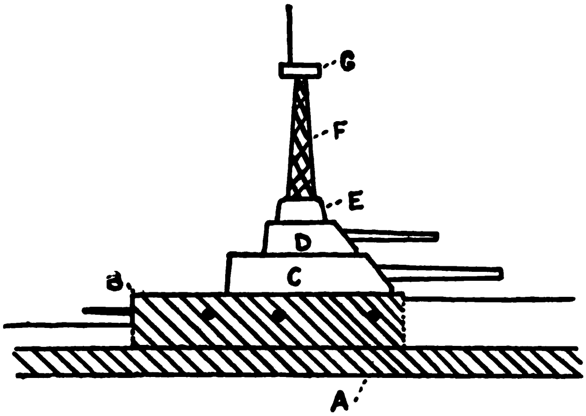
During the 1880 decade most of the naval Powers took a sudden dislike to the closed turret, and in its place was adopted the open-top barbette. This system had many advantages—it saved a good deal of weight and enabled the guns to be placed at a higher level than was possible with the heavily-armored turret; but, on the other hand, the breech end of the guns, and the guns' crews, were left entirely unprotected. It was curious that the introduction of the efficient quick-firing gun coincided more or less with the appearance of the open barbette, and, not unnaturally, quickly put an end to it.

The barbette, however, did not entirely disappear, but there was devised a convenient half-way house between it and the turret. This was at first known as the hooded barbette. It retained to some extent the protection which the closed turret afforded to the guns' crews, while it also had the advantage of the protected base, a feature that was missing in most of the early turret-ships. Hooded barbettes came after a time to be referred to simply as "barbettes," but it is now almost the universal custom to call them "turrets"—and they certainly have more in common with Ericsson's invention than with the open-top gun-house that may be said to have reached its climax in the British battleship *Benbow*, in which a 110-ton gun was mounted on the top of a tower at either end of the superstructure.

We have thus returned to the *Monitor* ideal of a completely protected gun's crew. Just as surely we are approaching again the ideal of 360-degree arc of fire. Indeed, so far as modern tactical conditions require it, this may even be said to have been attained in all those vessels (including all the American and several foreign dreadnoughts) in which it is possible to concentrate all the heavy guns on either broadside. Nevertheless, naval authorities still seek to increase the efficiency of their ship-armaments in this direction; but it will be realized that so long as six, five, four or even two turrets are placed in different positions in a ship it will be impossible to secure a complete arc of fire from all the guns. For, even if masts and funnels are eliminated, there will always be an arc in which the fire of one turret is screened by the other, or by several others.

With this fact in mind it is interesting to refer to a suggestion recently put forward by Signor Lorenzo d'Adda, a well-known Italian naval architect. The suggestion is really a development of the idea embodied in the *New Jersey* class, but instead of only one turret being super-imposed on another the whole of the necessary protuberances above the deck are placed one on top of the other. A sketch of this arrangement is given herewith, the vessel itself being assumed to be driven by internal combustion engines.

In its essentials the turret has really changed very little in the fifty years of its life; but latterly it has shown signs of unexpected developments. The *Monitor's* turret contained two 11-inch Dahlgren guns; and it was not until August, 1910, that the first ship was launched which is to carry three guns in each turret. This was the Italian battleship *Dante Alighieri.* The guns in these turrets will be mounted in the form of a triangle, two being on the lower level and the third above and between them. In addition to the *Nevada* and *Oklahoma*, the triple turret has also been adopted in certain Russian and Austrian ships, but in each case it is believed the guns will be mounted abreast.



1155

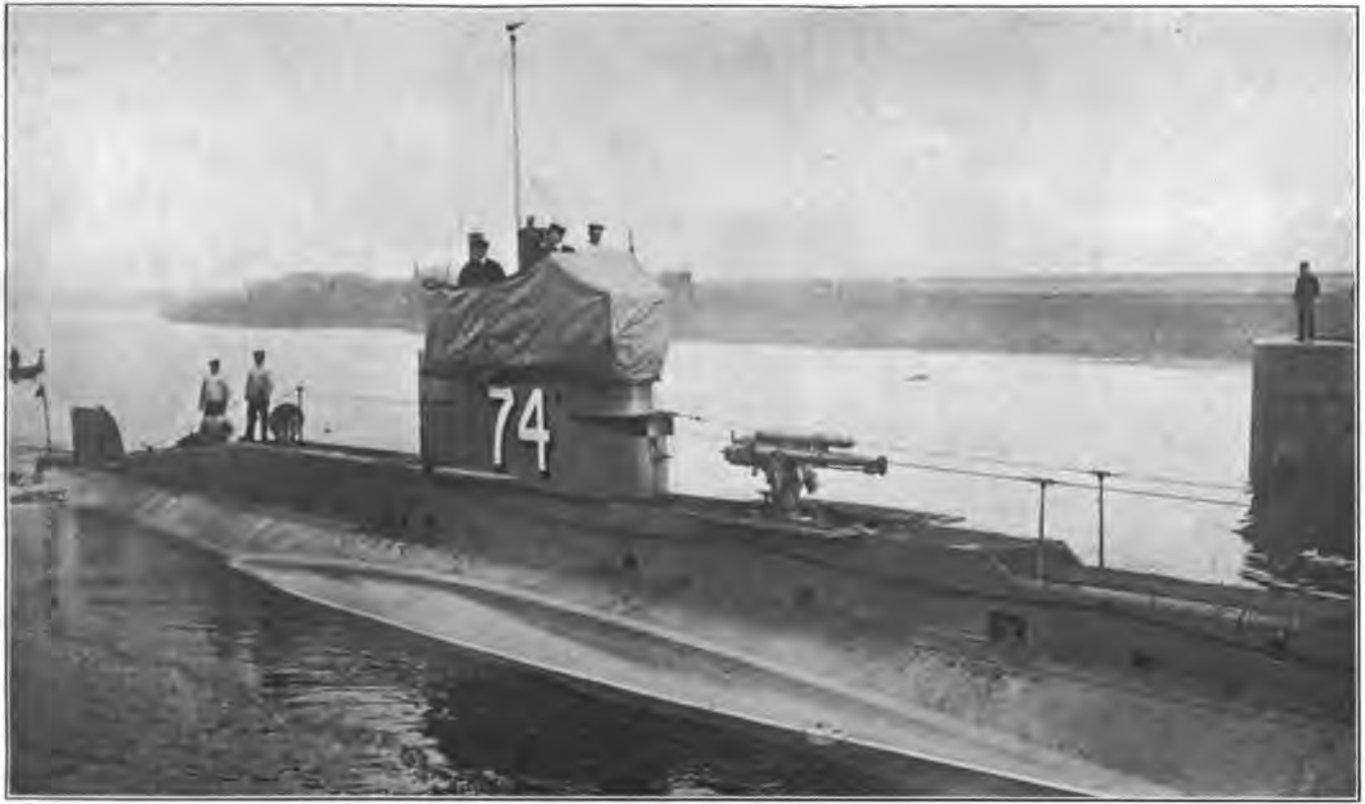
LORENZO D'ADDA'S SUGGESTION FOR SECURING ALL-ROUND FIRE IN A MOTOR-DRIVEN BATTLESHIP

A. Water-line armor belt. B. Anti-torpedo battery (eight 3.9-inch). C. Main armament (three 14-inch). D. Secondary armament (two 7.5-inch). E. Conning tower. F. Lattice mast. G. Fire control platform. Hull armor, shaded; maximum thickness 15.7 inches. 8,200 tons. 12,600 horsepower. 22 knots

A proposal for a six-gun turret has also been put forward recently by the Italian architect already referred to. The guns project in pairs, each pair making an angle of 120 degrees with the other. The advantage claimed in this case is saving of weight and space, and rapidity of fire, since while one gun is being fired the others can be loaded and prepared. It is estimated that twelve guns mounted in this manner would demand 30 per cent less weight than if they were distributed over six turrets; and also that twelve 12-inch guns could easily be carried on a displacement of 16,000 tons.

—*Scientific American*, February 17, 1912.

✣ ✣ ✣



Photograph by Boston Photo News Company 1156

One of the latest British submarines. A unique feature is its equipment with a rapid fire gun, which disappears thru a hatch when the boat is submerged

[illegible]

THE BATTLESHIPS OF THE NEW "KAISER" CLASS

Those who follow the progress of naval construction have been puzzled at Germany's reluctance to adopt the 12-inch gun and the steam turbine. Considerable interest is therefore attached to the change of policy which is embodied in the design of the *Kaiser* class ships.

The first two squadrons of German Dreadnoughts—the four *Nassaus* and the four *Helgolands*—were designed with alternative engines at a time when Great Britain possessed an equal number of "all big gun" turbine

TABLE I.

Name of ships.	Ships they substitute.	Building firm or yard.	System of turbine.	First instalment granted in April.	Date of launch.	To be commissioned in autumn.
Kaiser . .	Hilderbrand	Kiel .	Parsons . .	1909	22nd Mch., 1911	1912
Frederich d. G.	Heimball	Vulcan	A.E.G. Curtiss	1909	10th June, 1911	1912
Kaiserin .	Hagen .	Howaldt	Parsons . .	1910	11th Nov., 1911	1913
Kon. Albert	Aegir . .	Schichau	Schichau .	1910	. . . .	1913
Prg-Luitpold	Odin . .	Germania	Germania .	1910	17th Feb., 1912	1913

TABLE II.—*Comparison of Gun Power.*

Number and name of ships.	Displacement. Tons.	Speed. Knots.	Primary and secondary battery.	Guns firing.		
				Astern.	Broadside.	Ahead.
(5) Kaiser	24,500	21–22	10 12in.	8 12in.	10 12in.	6 12in.
			14 6in.	4 6in.	7 6in.	4 6in.
(3) Conte di Cavour	23,000	22	13 12in.	5 12in.	13 12in.	5 12in.
			20 4¾in.	6 4¾in.	10 4¾in.	6 4¾in.
(4) Jean Bart	23,500	20	12 12in.	8 12in.	10 12in.	8 12in.
			22 5½in.	8 5½in.	11 5½in.	8 5½in.
(2) Settsu	21,100	20.5	12 12in.	6 12in.	8 12in.	6 12in.
			10 6in.	2 6in.	5 6in.	2 6in.
(2) Hercules	20,600	21.5	10 12in.	8 12in.	10 12in.	6 12in.
			16 4in.	4 4in.	8 4in.	2 4in.
(4) Viribus Unitis	22,000	20.7	12 12in.	6 12in.	12 12in.	6 12in.
			12 6in.	2 6in.	6 6in.	2 6in.
(4) Petrapawlovsk	23,400	23	12 12in.	3 12in.	12 12in.	3 12in.
			16 4¾in.	6 4¾in.	8 4¾in.	6 4¾in.
(2) Arkansas	27,700	21.3	12 12in.	4 12in.	12 12in.	4 12in.
			21 5in.	5 5in.	10 5in.	8 5in.
(2) Moreno	28,000	23	12 12in.	8 12in.	12 12in.	8 12in.
			12 6in.	2 6in.	6 6in.	2 6in.

ships built or building. The 12-inch gun appears for the first time in Germany in 1910, that is, when this caliber had been abandoned in England, and the *Orion* announced the dawn of the 13½-inch gun era. If the *Helgoland* class marked the advent of the new German gun, the ships of the *Kaiser* class claim the distinction of being Germany's first turbine Dreadnoughts. Some data concerning the building of these vessels is given in Table I.

It has been reported that one ship of this class had been selected to carry out an experiment on a large scale of propulsion by means of internal combustion engines. The Diesel motor would supply from 10,000 to 12,000 horsepower, that is, about one-third of the whole motive power. A cylinder of this motor, designed and built by the Maschinenfabrik Nurnberg, was submitted to a series of tests in January last in the presence of naval officials, but a very severe accident put an end to these trials for the time being.

The dimensions of the ships of the new *Kaiser* class are:—Length, 564.3 feet; breadth, 95.15 feet; draught, 27.2 feet. Their displacement is 24,500 tons, and the official figures for speed and power are given at 21 knots and 25,000 horse-power; but a speed of 22 knots is expected, and the actual motive power will probably be one-third more than that which has been mentioned above.

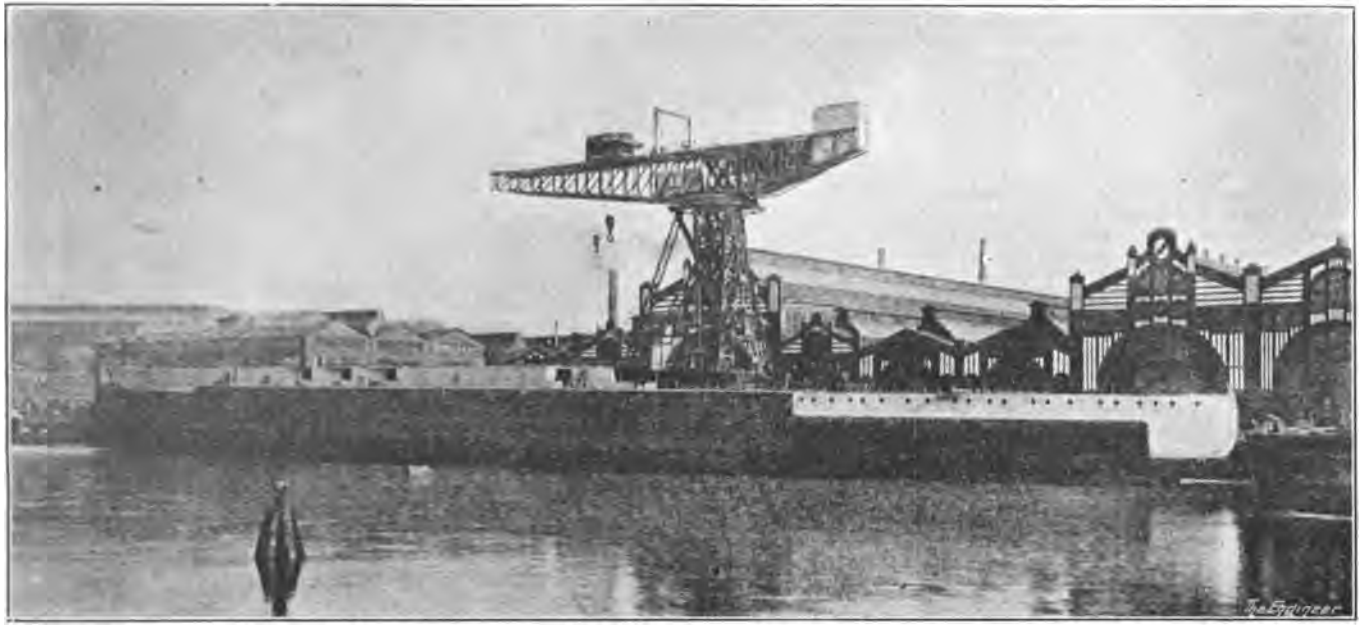
A feature of these new battleships will direct the attention of the naval artillerists to a radical change of policy of the German Admirality in the distribution of the primary armament. The gun positions of the *Kaiser* class vessels are illustrated by the sketch, * * * Fig. 4 [page 100].

As will be seen, the two so-called "reserve" gun positions to port and starboard, which up to the present have been a prominent feature of German dreadnoughts, have been abandoned, and the same distribution of big guns has been adopted which has proved so successful in Germany's latest armored cruiser, the *Moltke*. This disposition, which seems to be a compromise between the typical British armament of armored cruisers and that of American battleships, will also be a feature of the next group of 14-inch gun battleships—the *Ersatz Weissenburg*, the *Ersatz Kurfurst Friedrich Wilhelm*, and "*S*." A standard and uniform type of gun distribution will thus be adopted for all German capital ships, which will increase considerably their tactical value.

The main armament of the *Kaiser* class ships consists of ten 12-inch guns mounted in five turrets, one forward, two aft, and one on each side. Thus, on paper, six guns will fire ahead, eight guns astern, and all ten broadside. The firing arc of the middle turrets is 180 degrees + 70 degrees, that of the forward and after turrets about 300 degrees. These paper values will, of course, be much reduced in the actual battle training of guns, but anyhow the armament plan of the *Kaisers* is a notable improvement on that of the *Nassaus* and *Helgolands*, in which only two-thirds of the gun power could be employed on broadside fire, half ahead and half astern.

The gun distribution of the main armament of the *Kaiser* and class differs greatly from that adopted in other navies, with the exception of the British ships of the 1909 programme, the *Hercules* and *Colossus*. In Table II., * * * [page 95], a comparison of gun power is made between the *Kaiser* and the representative 12-inch gun-armed ships of other navies.

The comparison also shows that opinion is much divided with regard to the secondary armament. Germany and Japan, which have never abandoned the 6-inch gun, have been followed by Argentina and Austria in the choice of the anti-torpedo boat artillery. In this respect Germany seems

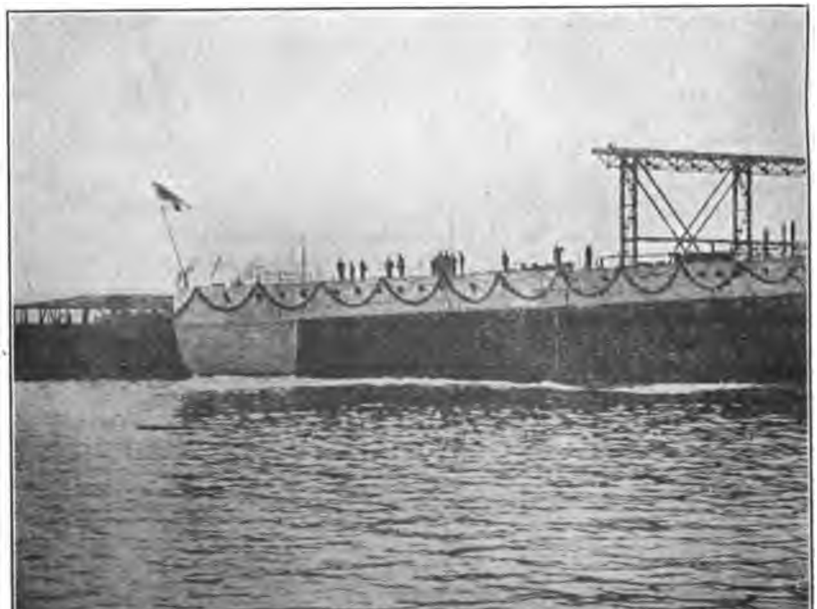


The Engineer 1158

FIG. 1.

THE GERMAN BATTLESHIP PRINZREGENT LUITPOLD to lead naval thought, the general trend of which is inclined toward an increase of gun power to cope with the ever-increasing power of the armament of flotillas.

Figs. 1, 2, and 3 illustrate the latest ship of the *Kaiser* class—the *Prinzregent Luitpold*—launched at Kiel on February 17th, at the present stage of construction. The armor, as Fig. 1 indicates, covers almost the whole of the ship's sides and extends from the stem to the steering gear position aft. Side armor is composed of a very deep water-line belt, citadel protection extending from stem to the aftermost gun turret, and of a casemate reaching from the forward gun turret to the second 12-inch gun mounting aft. Fig. 3 shows the bow of the ship, and Fig. 2 gives a view of the vessel just entering the water.



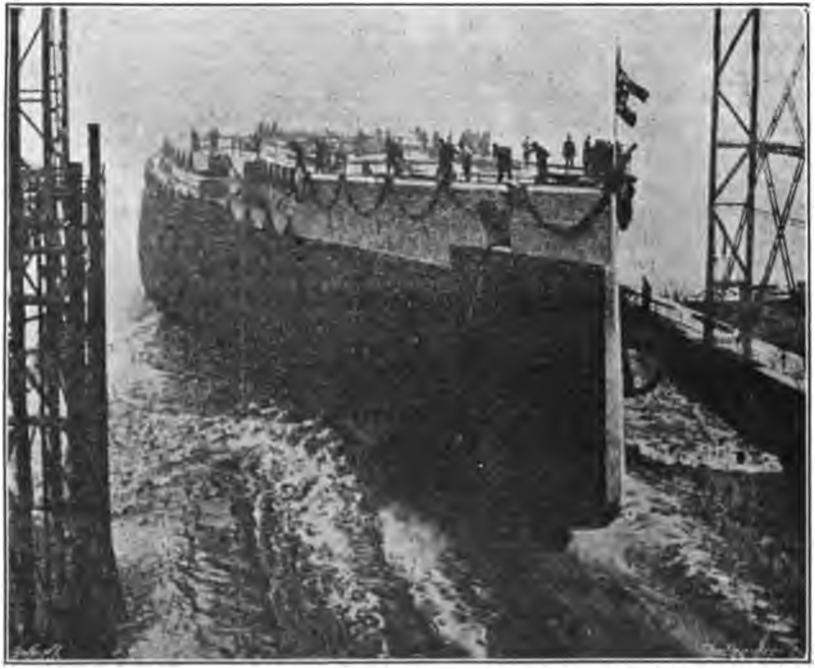
The Engineer 1159

FIG. 2.

The great advantages of a uniform caliber for all capital ships and the somewhat overrated ballistic qualities of the 11-inch—28 cm.—are for the greater part responsible for the conservatism typical of German ordnance up to 1908. Great importance was also attached to the number of rounds which could be fired by the 11-inch weapon, and which is reduced to eighty or ninety in the new 12-inch gun. But once the change of caliber was decided upon the combined effect of designers and naval officials have all been directed to produce a gun more efficient, if possible, than the British 12-inch gun. Thus the Krupp gun of 1909-1910 was the "reply" to the guns mounted on the *Colossus*, *Neptune*, *St. Vincent*, and *Indefatigable*, and as soon as the armament of the *Orion* and *Lion* became known, Germany began to search for a "reply" to the British 13½-inch gun.

The days of the 12-inch gun are now numbered, and all signs seem to indicate that the definite standard of Germany's big caliber will be the 14-inch gun. The first successful experiments carried out by Krupp in 1910 with a large caliber gun designed to beat the records of the 13½-inch gun adopted in the naval programme ships of 1909—*Orion* and class—has led to an order being placed with the Essen factory for thirty 356 mm.—14-inch—guns of the 1910 model.

It may be inferred that this ordnance will constitute the armament of the Super-Dreadnoughts laid down in 1911 at Wilhelmshaven, Bremen and Hamburg, which will be ready for service late in 1911. To return to the armament of the *Kaiser* class, the ballistics of the German 12-inch piece are said to be superior to those of the corresponding weapon, Mark XI. and XII. The life of the new gun is 20 per cent. to 25 per cent. shorter than that of the 28 cm. —11-inch—gun of the *Nassaus*, and has been estimated at a maximum of ninety rounds fired without altering the ballistic properties. The weight of each gun position, including armor protection of the turret, is about 550 tons, so that the weight of the main battery amounts to 2750 tons. The weight of the projectile is given at 390 kilos. uncapped and 434 kilos. with cap. It does not therefore differ much from the weight of the English



The Engineer 1160

FIG. 3.

shell of equal caliber, and is somewhat lighter than the corresponding French projectile.

If strikes do not delay their completion the *Kaiser* and *Friedrich der Grosse* will be ready for trials in the course of this summer, thus slightly reducing the average time of construction of the previous ships. The figures given below show the time for building the German Dreadnoughts now in comission:—

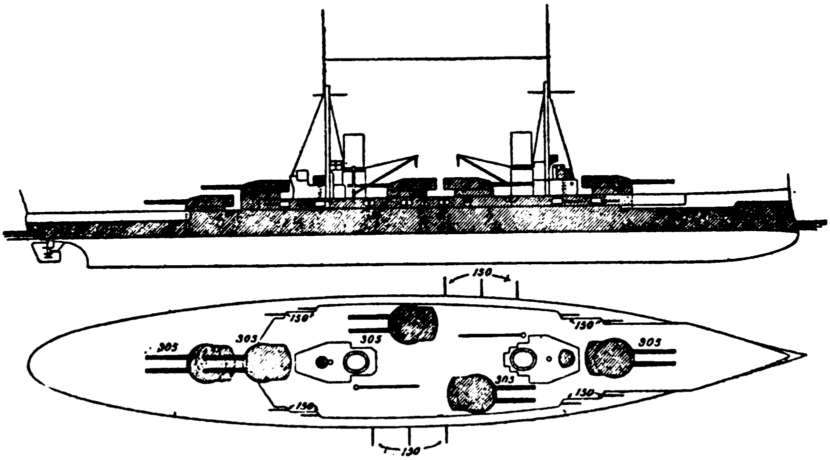


FIG. 4.

Protection and Armament of Kaiser Class

Name of ship	Builder	Months
Nassau	Imp. Yard, Wilhelmshaven	40
Westfalen	Weser Works, Bremen	37
Rheinland	Vulcan, Stettin	37
Posen	Germania, Kiel	38
Helgoland	Howaldt, Kiel	39
Ostfriesland	Imp. Yard, Wilhelmshaven	40
Thuringen	Weser, Bremen	37

It is estimated that the *Kaiser* class ships will be ready for commission thirty-six months after the laying of the keel.

—*The Engineer*, March 29, 1912.

* * *

H. M. AUSTRALIAN CRUISER MELBOURNE

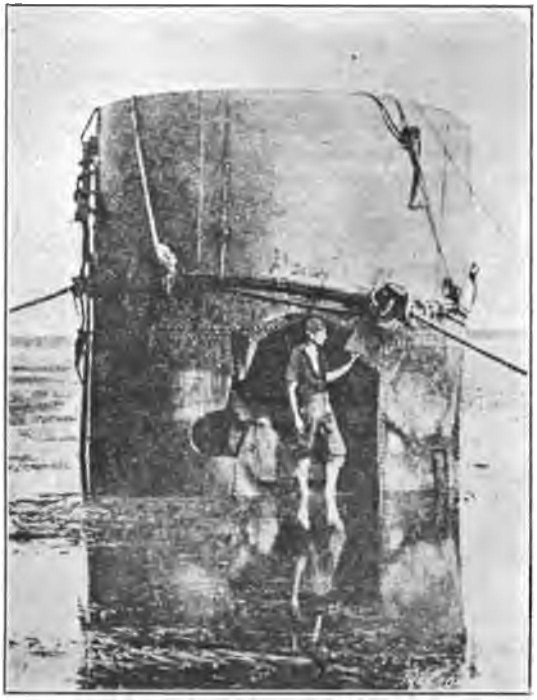
The launch of the cruiser *Melbourne* at Cammell, Laird and Co's. works at Birkenhead on the 30th ult. has special significance, as it marks a new and definite naval policy undertaken by one of the Dominions of the Crown. The new Australasian navy, of which the *Melbourne* will form part, will comprise modern cruisers, torpedo boats, and submarines. It will further necessitate the maintenance by this colony of training establishments, dockyards, and factories. The *Melbourne* was designed by Sir Philip Watts, Chief Constructor of the Navy; is 456 feet 10 inches long overall, 430 feet between perpendiculars, and 49 feet 10 inches in breadth, and her displacement at load draught is about 5600 tons. She will carry eight 6-inch guns, two broadside torpedo tubes, and will have a storage capacity for seven torpedoes. Protection is afforded to the water line and the hull above this line by an armor belt extending the whole length of the ship. The thickness of this belt is 2 inches amidships. Further protection of the vital machinery is afforded by the coal bunkers. The inner bottom is continuous throughout the magazine, machinery and shell room spaces, and the hull is divided transversely and longitudinally with water-tight bulkheads.

The vessel will be propelled by steam turbines of the Parsons type, arranged to drive four shafts, each of the shafts being available for going either ahead or astern. The designed revolutions when the machinery is developing full power will be about 500 per minute. The condensers are of the Uniflux type, and are designed for the high vacua necessary with turbine machinery. The water-tube boilers are of the three-drum small tube type, the tubes being $1\frac{1}{8}$ inches and $1\frac{3}{8}$ inches diameter. The boilers are primarily intended for burning coal, but special arrangements have been made to enable oil fuel to be burned in conjunction with coal when this is necessary. Many improvements have been made in the machinery as a result of the experience which has been gained in previous vessels of the class. The whole of the steel forgings in connection with the turbine machinery have been manufactured at the shipbuilders' steel works at Sheffield.

The ship is electrically lighted throughout internally by incandescent lamps, and arc lamps for use when coaling have been provided. For coaling purposes two electrically driven coaling winches will be used. They are capable of lifting one ton to a height of 40 feet at speeds varying from 75 feet to 200 feet per minute. The ammunition hoists, the ash hoists, and the after capstan are all electrically driven. The forward capstan placed on forecastle deck can be worked by steam or hand. The officers are berthed aft on the lower deck and on the starboard side of the upper deck. The crew occupy the forward portions of these decks. Ten electrically driven $12\frac{1}{2}$-inch fans will supply air to the magazines, shell rooms, steering compartments, engineers' workshop, and working spaces beneath the lower deck, and also to the cabin and crew spaces, etc. The engine-rooms will be closed down for action and ventilated entirely by 20-inch and 25-inch electric fans.

Electrically driven reciprocating pumps with auxiliary hand gear for drawing water from the sea and delivering it to a sanitary tank, also for the distribution of fresh water to the various apartments, are part of the equipment. The steering gear, which is of the screw pattern, is worked by steam or hand, and is controlled from the bridge by telemotor gear. The wireless telegraphy installation is according to the latest Admiralty requirements. There are four searchlights placed in suitable positions and a comprehensive arrangement of voice pipes, telegraphs, and telephones. The ship will be manned by about 400 officers and men.—*The Engineer*, June 7, 1912.

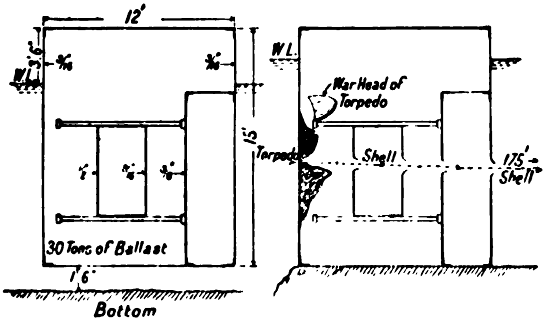
* * *



The Engineer 1163

FIG. 2.

The target after attack



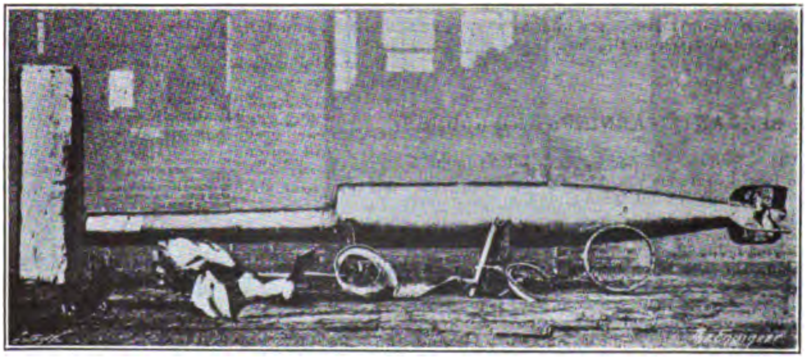
1164

FIG. 3.

The target before and after attack

to $\frac{3}{8}$ inch, the intermediate bulkhead being of plating $\frac{3}{16}$ inch thick. This arrangement was intended to simulate the inner and outer skins and the suplemental water-tight caisson construction which the French introduced so successfully some years ago as a defense against the torpedo, thus providing a large air space for the absorption of a big part of the violence of the gun-cotton's explosive gases. We know from actual experiences during the Russo-Japanese War how successful this general form of under-water defense was against the torpedo, and how, too, it greatly reduced the damaged area due to bursting contact mines.

Without going into details of the test, it is sufficient to know that the Davis torpedo was guided against the target by a wire, and the weapon hit the structure at a point 5 feet below the water-line and pierced the structure through and through, the shell finally embedding itself in the mud 175 feet beyond the far side of the target. On the attacking side the outer plating was badly torn over a considerable area, owing undoubtedly to the propulsive gases of the gun, but the succeeding bulkheads were all cleanly perforated. A portion of the warhead of the torpedo landed inside of the target, but the gun and the air flask and the afterbody of the torpedo were driven back by the recoil a distance of 40 feet away from the point of assault. This gives some idea of the forces developed by the gun, as well as the remaining velocity of the shell after it had gone through the target. Fig. 4 shows the torpedo recovered after the attack. It will be seen that the gun is still attached to the rear portion. The shell of the forebody will be observed on the left-hand side, and other pieces are resting on the ground.



The Engineer 1165

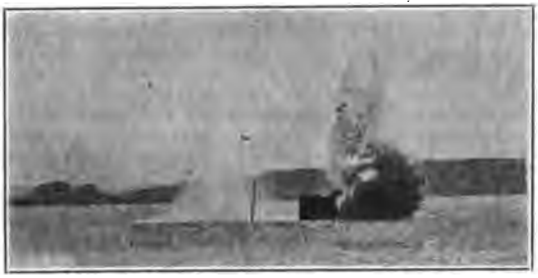
FIG. 4.

The torpedo recovered after the attack

The conclusion to be drawn from this demonstration was that a torpedo of the Davis type, even if stopped by a torpedo defense net, would at that distance from a ship's side be able to send its projectile through the net and the intervening water space with sufficient remaining velocity to carry the shell through the hull and a defensive bulkhead right into the vital region.

The prime idea of this torpedo is concentration of the attacking power, and nothing could show better the attainment of this end than the very moderate surface disturbance produced by the liberated gases of the gun at the time the target was hit—see Fig. 5. A thin column of water was blown to a height of about 31 feet, and the disturbed area was a small one.

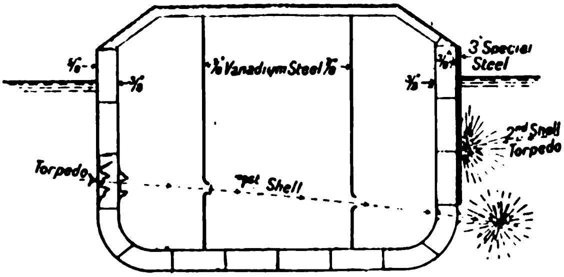
Since the foregoing test the United States Navy Department has given the Davis gun-torpedo a trial in the lower waters of the Chesapeake Bay, and, while the officials have not made public their report, still, the general results have become known. The caisson or target was a composite affair, designed to represent a vessel without under-water armor on one side of the structure, and on the other side a supplemental defense of steel plating 3 inches thick, as shown in Fig. 6. There were two internal bulkheads of vanadium steel, each $\frac{7}{8}$ inch thick. The torpedo was guided to the desired point of attack by means of a trolley wire. The first shell passed through the outer and inner bottom plating, perforated each of the succeeding vanadium steel bulkheads, and thence through the inner and outer plating, exploding in the water beyond. In the second attack, after the torpedo had been repaired, and also the target, the projectile exploded on the outside of the specially treated 3-inch plating, and failed to penetrate, although this defense was broken through. The target sank because, as the Navy Department announced, "of the straining of its frame and consequent leakage." The gun-torpedo was a better form of the Davis weapon than that previously



The Engineer 1166

FIG. 5.

The disturbance at the moment of attack



1167

FIG. 6.

Experimental target

tested privately, and it is said that the projectile had a muzzle velocity of quite 1000 foot-seconds.

So far as common knowledge goes, the bulkhead defense against torpedoes of none of the battleships built or being built is thicker than 1.77 inches, and in the latest vessels the average is about 1½ inches. The trajectory of the first shell fired by the Davis gun-torpedo in the recent Government test indicates clearly how futile even 2 inch plating would be against the attack of the under-water projectile.

Better to grasp the details of the Davis gun-torpedo, reference to Fig. 7 will give a graphic idea of the weapon and its general arrangement. The comparatively remarkable lightness of the gun makes it possible, thanks to modern science, to do what might seem quite impossible, *i. e.*, install an 8-inch rifle of sufficient length to give its projectile the energy required to drive it through 4 inches or 5 inches of hardened steel. By placing the gun largely within the confines of the air flask, it is possible to distribute the weights to better advantage, and that, too, without imposing a prohibitive length upon the torpedo. A thin water-tight bulkhead or diaphragm seals the muzzle of the gun; water cannot enter the rifle until the shell has burst through this plating. By this means the shell is unimpeded during the interval it is gathering velocity, and the gun is untaxed by the stresses to which it would be subjected if it were obliged to start the projectile against a wall of water.

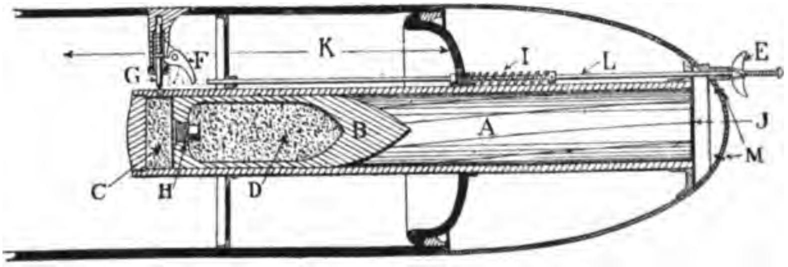


FIG. 7.

Arrangement of the Davis torpedo gun

While the primary idea has been to furnish a gun capable of being fired but once, careful calibrating after a single discharge has failed to show the slightest deformation of the bore. This is quite remarkable, in view of the fact that the walls of the gun have been but ½ inch thick, and indicates that a heavier propulsive charge could be used if anything were to be gained by a higher velocity. The outer casing of the head of the torpedo is water-tight, but the small plugs M are designed to be driven in the instant the nose hits the target, thus providing an easy escape for the gun gases, liberating the air just inside, and permitting the water to enter the nose. When the torpedo is launched, the propeller E holds the firing-rod securely, preventing its rearward movement toward the trigger F. After travelling through the water a short distance, the propeller works forward to the stop *e*, and thereafter the firing-rod can be driven backward far enough to engage the trigger.

in order to keep the rod in a safe position until struck something of a e, the spring I keeps the rod L pushed forward. When the firing rod is forcibly driven rearward, it raises the firing pin G, which, under the recoil of a spring, descends upon the gun primer.

The length of the bore is sufficient to insure acceleration to the desired velocity before the projectile leaves the gun, and an increase of velocity could be readily obtained by lengthening the rifle and extending it further into the air flask without seriously injuring the capacity of the latter. This arrangement also interferes least with the center of gravity of the torpedo. When the projectile bursts through the thin diaphragm J, the gun gases find a ready exit thence through the already weakened and perforated nose. For ordinary practice, in time of peace, a blind shell may be loaded into the rifle, and the torpedo run in a manner similar to the ordinary torpedo using an exercise or collapsible head. As the nose of the torpedo is removable, the gun can be loaded for service easily and quickly, and the firing mechanism is readily shifted so as not to interfere with this operation. A manhole in the afterpart of the casing—sealed properly afterwards—permits of the priming of the gun.

It will be clearly seen that the discharge of the gun does not react upon the air flask, as is certainly the case when the gun-cotton charge of an ordinary torpedo is detonated, and, as a result, none of the directive force is absorbed in this manner by the air space in the flask.

—*The Engineer*, February 23, 1912.

◆ ◆ ◆

THE RAPIDITY OF FIRE OF NAVAL GUNS

The Admiralty has just issued the record of results of the gun practice in the Navy in 1911, and these must be pronounced as most satisfactory, indicating a high efficiency not only of "the man behind the gun," but also of the ordnance machinery on board. Last year there were a greater number of ships participating in the gunnery tests than for seven or eight years past, the total being 127, as compared with 117 in the three preceding years, consequently a larger number of guns were fired, the total being 1496, as compared with 1318 in the previous year. This number of guns, indeed, is the highest used in the gun tests for the years embraced in the official returns. With these guns 8228 rounds were fired in the tests, and fully half of these were hits. The conditions this year were again altered; ricochets were only counted as three-tenths of a hit, and under these conditions the percentage of hits to rounds fired was 50.01. If the ricochets made last year had been reckoned as whole hits, as was the case in the previous years, the rate would have been 54.86 per cent., which compares with 51.85 per cent. in the previous year, 54.12 per cent. in 1909, 53.57 per cent. in 1908, and 42.70 per cent. in 1907. This last was the year when the targets were reduced in size, and the ship's speed, when firing, was increased. But since then the conditions have been made more onerous, because there is now no choice given to the various fleets as to when the battle-practice is to take place, so that in some cases the trials have been carried out in unfavorable weather.

The average rate of hits per gun per minute for the 12-inch and 10-inch guns, including all ships of the fleet, is 0.58. The best performance of any ship for the 12-inch gun was 2.31 hits per minute, by the battleship *Russell*, in the Mediterranean fleet. The next ship is the *Queen*, with 2.07 hits per minute; the *Britannia* coming third with 2.04; then follow the *Venerable* and *Implacable*. The first Dreadnought on the list is sixth, the *Superb*, with a record of 1.76 hits. This must be reckoned as a good result. In other words, within the given time 17 direct hits were recorded, in addition to four ricochets; whereas the first two ships on the list, the *Russell* and the *Queen*, fired together 31 shots, resulting in 16 hits and two ricochets. The seventh on the list is the *Neptune*, also a Dreadnought, which has 1.71 hits per minute.

The best performance for the 10-inch breech-loading gun was 1.67 hits per minute, while in the case of the various types of 9.2-inch guns the hits per minute were 3.34, 4.19, and 2.53, while the average for the whole fleet was 1.90. It would appear, therefore, that, on an average performance, the rate of fire of the 9.2-inch gun on last year's showing is three times greater than that of the 12-inch gun; but this is probably accounted for by the rule that the larger number of 12-inch guns fired, as compared with 9.2-inch guns, tends to bring down the average. The best performances of the guns of the two calibers indicate that the 12-inch gun may be equal to something like 60 or 70 per cent. of the rapidity of fire of the 9.2-inch gun. The 7.5-inch gun achieved a rapidity of hits per minute of 5.53 in the best ship, and of 2.78 on an average.

There are various marks of 6-inch gun in use; the average performance for all of these marks in all ships is 3.89 hits per minute. In the latest gun, of the breech-loading type, the best attained was 6.33, in one of the new *Town* class of cruisers, the *Glasgow*. The earlier mark was equally satisfactory, and showed a greater uniformity. With a 6-inch quick-firer, one of the China ships—the *Flora*—achieved 6.82 hits per minute. The results in other ships range down to 1.50; no doubt there is some explanation why one ship should attain only 20 per cent. of the hits achieved by another ship of practically the same class. The *Flora* also achieved first place with her 4.7-inch guns, the rate of hits being 5.88 per minute. In the case of the 4-inch gun the best performance is 7.43 hits. It is notable, too, that the battle-cruisers that were fitted with this gun as a torpedo-boat repeller have all come out well, the *Inflexible* having got 7.30, the *Invincible* 6.75, and the *Indomitable* 5.35 hits per minute. In view of the discussion as to the relative rapidity of fire of the 4-inch, 4.7-inch, and 6-inch rapid-firing guns for repelling torpedo-boat attack, the best results are worth quoting in juxtaposition:—The 4-inch gave 7.43 hits, the 4.7-inch 5.88 hits, and the 6-inch 6.82 hits. It would therefore seem that, from the point of view of rapidity of hitting, there is no desirability so far as the larger-caliber gun is concerned.

A separate return gives the results of the tests of light quick-firing guns in the various fleets. The number of ships participating in the tests shows an increase on previous years, but the number of guns of this small class have been considerably reduced. In all 6126 rounds were fired, and the percentage of hits was 42.84, a ricochet only counting as three-tenths of a hit. In the case of the 12-pounder gun the hits per gun per minute averaged 5.253; in the case of the 6-pounder and 3-pounder guns, excepting the Vickers gun, the average was 3.820, while the Vickers 3-pounder gun is returned as having an average of 5.642. The best performance, however, of these respective guns was enormously greater, being respectively 20.45, 18.71, and 20. The disparity between the average and the best shows the enormous scope for improvement, although it must always be remembered that as the ships have to go out in whatever weather prevails on the appointed day, weather conditions must have affected the performance of some ships. As regards the torpedo-boat destroyers, the return shows that 190 of these craft participated in the year's tests, the number of guns being 823; and of 4428 rounds fired, 42.09 per cent. were hits. The average hits per gun per minute for the whole fleet was 2.56 in the case of the 4-inch breech-loader, 3.51 in the case of the 12-pounder 12-cwt. guns, 3.64 for the 12-pounder 8-cwt. guns, and 6.48 for the 6-pounder breech-loader. The best performance, however, is enormously better than the average; in some cases the gunners failed to make a hit in the test. Thus the highest achieved for the 4-inch breech-loader was 7.37; for the 12-pounder 12-cwt., on one type of mounting, 9.68, and on another 10.07; for the 12-pounder 8-cwt., 12; for the 6-pounder, with telescopic sights, 20.57; and without the telescopic sights, 6 hits were achieved. —*Engineering*, February 23, 1912.

◆ ◆ ◆

TESTING AEROPLANES

Since the French Minister of War placed his veto upon the use of monoplanes until such time as their construction should be so far improved as considerably to reduce the risk of accident, the makers of these machines have been investigating all sorts of means for giving satisfaction to the War Department. It seems to be unquestionable that the collapse of so many monoplanes, whereby several officers lost their lives was due to defective construction. In many cases absurdly weak connections were used for stays which were sufficiently strong for the loads put upon them. As the result of the veto of the War Department the building of monoplanes has entered upon a more serious phase. In order to obtain some reliable data as to the limit of resistance of aeroplane parts the military authorities are carrying out a series of experiments with the aid of the Northern of France Railway Company, which has placed at their disposal a locomotive to which is attached a truck carrying dynamometric apparatus, and hauling a second truck with the aeroplane. The fore end of the monoplane body, to which the engine is usually attached, swivels on a cross-bar held by two solid uprights fixed and braced to the truck. While the locomotive is traveling from 63 to 68 miles an hour the officer who acts as pilot maneuvers the machine in the usual way, and endeavors to subject every part to the maximum possible strains. These tests will be continued until something gives way. It is hoped by these means to ascertain exactly what are the weakest parts of the monoplane, and as the conditions of stresses and pressure are the same as those obtaining in actual flight, except of course the strains set up by the engine and propeller, these experiments should provide valuable data for the builders of aeroplanes. Seeing that the national subscription has placed at the disposal of the French Government more than one hundred machines in cannot afford to run any further risk.—*The Engineer*, June 7, 1912.

◆ ◆ ◆

A NEW SAFETY EXPLOSIVE

RESISTANT TO ALL SHOCKS AND TEMPERATURE CONDITIONS

A most interesting series of tests of a new explosive was conducted on Wednesday, May 15th, at the site of the new reservoir near Valhalla, N. Y. The material, which is protected by a patent issued to the inventor, the Marquis Roberto Imperiali, consists essentially of a mixture of ammonium nitrate (80 parts by weight), potassium nitrate (5 parts by weight) and aluminum powder (15 parts by weight), to which may be added a suitable bonding agent. As such, a mixture of mononitrotoluol, glycerine and collodion to which a small quantity of potassium permanganate may be added, is suggested. The new explosive has been named "imperialite" after its inventor.

The new explosive possesses some exceedingly remarkable properties, chief among which is, perhaps, its extraordinarily high resistance to all kinds of influences, such as with most other explosives would lead to disastrous results; thus, for example, the powder can be heated quite safely up to some 900 degrees F. without any explosion. It simply undergoes partial sublimation, without any other violent change. The material can also be hammered and subjected to any kind of shock without the slightest fear of accident. This was demonstrated to the audience which attended the test, both a cartridge of the material and also some open powder being subjected to hammer blows without any explosion resulting. It should be remembered that dynamite, for example, is apt to explode under shock, especially when frozen, and that many serious accidents have occurred through this cause.

To give an indication of the blasting properties of the new compound, a number of charges of imperialite and of other explosives, by way of comparison, were fired in heavy lead cylinders, one of which is shown in near view in our illustration.* This cylinder had a hole bored in it, of a volume 67 cubic centimeters, this hole being closed during the test by means of a metal plug which was fastened down, as shown in the illustration, by means of a cross bar and bolts.

The following results were obtained and may serve to show the blasting properties of imperialite as compared with those of common blasting materials. Fifteen-gramme samples were used. The first test was performed with imperialite, and the cavity formed in the lead cylinder was measured by means of water poured into it. It was found to be 780 cubic centimeters. In a later test, performed under similar circumstances, the corresponding figure was 862. Compared with this the following figures were obtained with other materials: 40 per cent. DuPont forcite, 557 cubic centimeters; 60 per cent. DuPont forcite, 645 cubic centimeters; another sample of the 60 per cent. DuPont forcite, 655 cubic centimeters; picric acid (melinite) 620 cubic centimeters.

From all of these figures the original volume of the hole, measuring 67 cubic centimeters, as mentioned above, should be deducted to obtain a proper comparison.

It will be observed that, so far as these tests show, imperialite easily leads among the materials selected. The explosion is exceedingly sudden and the material is calculated for blasting purposes and not for the propulsion of projectiles, in the present state of development.

In conclusion a rather spectacular test was made. A large piece of rock was selected, for the blasting of which it had been estimated that about 1,200 grammes of dynamite would be required. A charge of 800 grammes of imperialite was placed in this and fired. In one of our illustrations the inventor is seen in the act of placing the cartridges in this rock. The other engraving shows the rock after the explosion. It will be seen that the thoroughness with which imperialite did its work leaves nothing to be desired.

As regards the cost of the new explosive, estimating ammonium nitrate at 7½ cents per pound, and potassium nitrate at 5 cents, aluminum at 20 cents, the total cost of the material of which the powder is made figures out to from 8 to 9 cents per pound.—*Scientific American*, June 1, 1912.

---

* Illustrations not reproduced herein.

◆ ◆ ◆

THE LAND-SIDE DEFENSE OF DEFENDED PORTS

By Lieutenant-Colonel F. E. G. Skey, C.R.E., Ceylon

I do not believe that much has been written on the subject of the defense of Defended Ports from the land side, and yet there is little doubt that if the fixed armament and the other coast defense works are in thoroughly efficient and up-to-date order, it is not from the sea, but from the land side that an attack, if such should ever occur, is to be expected.

It has been stated that this land-side defense is nothing but an ordinary operation of field warfare, but if this is true, it is only partially so, for there are many conditions which are peculiar to this kind of warfare, and I think it will be found when all these peculiar conditions are considered, that the ordinary methods of field warfare may require considerable modification to meet this special case.

The primary object of the defense of a Defended Port from the land side would appear to be to cover the rear of the coast defenses. These would probably be the objective of a hostile land attack, on the principle that when they have fallen, the port and all that it contains will be at the mercy of the victors. But, on the other hand, the attack may be directed against some other objective, an objective which may supply the reason for which the port is fortified, *i. e.*, either docks or coal stores, or even the shipping in the harbor, and, consequently, as part of the scheme of defense, the land-side defenses must cover not only the coast defense works but also every possible objective of a hostile attack.

At the same time, the separate coast defense works should each one be capable of individual defense. This is of course necessary as a protection against small landing parties or treacherous attacks from within our lines. But some of them should be prepared to offer a more vigorous resistance, and to form separate keeps or *reduits* to the main defenses. Even one such work may be able to deny the use of the harbor to the enemy's ships, and, in the case of a colonial port, the existence of a single *pied-a-terre* may make all the difference in the task of recovering possession of the whole colony. These works are not usually well adapted to defense on their land sides (the special conditions under which they are sited make such adaptation difficult to achieve), but they should nevertheless, every one, be prepared to give the best resistance possible, and some at least should be equipped with a view to a possible individual defense of several days.

It is an interesting question to discuss at what period the works of the land defense should be put in hand. One naturally thinks that if there is a period of warning and preparation before the outburst of hostilities, they should be carried out in that period. But yet, when one thinks of the number of Defended Ports in the British Empire, one trembles at the amount of destruction which will ensue when once the Royal Engineers are unloosed upon the peaceful inhabitants. Perhaps we should compromise and decide what should and what might not be done in this period; but then most people would say that if we are fortunate enough to get such a period everything should be done in it. There is one probable solution, however, that there is very little chance of such a period ever occurring.

with a small garrison. In this latter case the line of works might be a composite one, containing two distinct classes of works, those intended to contain a permanent garrison from the beginning, and those prepared in readiness to be occupied by the troops of the active defense, or others, under certain contingencies. The first of these two classes would consist, in the light of modern ideas, of a row of fortified groups or pivots, with wide intervening spaces left open for the free maneuvering of the troops allotted to the active defense. The second, which would be slightly drawn back in the intervals, would consist of smaller works, mutually supporting one another, and perhaps in some cases sited in chequerwise order, to cover effectually the gaps without obstructing them. It is impossible to lay down any hard-and-fast rule which will suit all cases, but we may take it for granted that there will be only one line, and that its ends, where they approach the coast, will rest on groups of works, of the nature of fortified pivots, which will tend to drive the enemy's attack inland and separate him from the support of his covering fleet.

It would be unwise to lay down any definite rules for the nature of the works, as they must depend chiefly on local conditions, but those near the coast must be heavily traversed and well concealed from all open water that is out of reach of the guns of the defense, while inland there would not be the usual objection to the occupation of walls and stoutly constructed buildings. A staple pattern of work might be the blockhouse, as being peculiarly adapted to economizing men and to covering important bridges and defiles, but it should always be surrounded with a low parapet which might extend, within the obstacle, slightly to the flanks, in case the enemy succeeded in bringing a gun or two into action. If the defense has mobile artillery and machine guns, a generous supply of alternative emplacements might be prepared for use when the guns are no longer required with the mobile force. In most places, too, a great deal of work will be necessary in improving communications; roads and bridges will have to be made or improved, and screens will no doubt be required to conceal our movements of troops from the enemy. So much for the provisional works, and we must not forget that each separate coast battery must be fortified and equipped to resist an independent assault, and that one at least should be prepared to act as a keep to the defenses.

The personnel of the defense divide themselves into various groups. We have already mentioned the relays of scouts or skirmishers who will have to hang on to the enemy and worry him continuously, and who would probably be detached from the troops reserved for active defense. These last are formed into a small force of all arms who are standing ready to move out and fight the enemy. The action of these troops is not easy to define, as each case will depend on the local and actual conditions. We can hardly count on having at our disposal very large numbers, and our troops may not always be of the best material, and, therefore, if we are likely to be out-numbered, the force must not advance far beyond the neighborhood of the land-side defenses, for, if they are cut off or badly defeated beyond the reach of support, the result may be fatal to the safety of the place. It is also to our advantage to draw the enemy as far as possible from his transports and from the covering support of his fleet. At the same time a weak defending force, by maneuvering in conjunction with one or two of the fortified pivots, and possibly supported by the fire of a gun or two of the coast defenses, might work out some very pretty tactical problems, and might lead even a strong body of assailants into considerable difficulties. The conditions would, of course, be entirely changed if the defending force is large in comparison with their opponents. Here they would have no reason to surrender the initiative, and could attack boldly in hopes of finding the enemy not yet fully prepared to receive them.

The next group are the garrisons of the defense pivots, who will, of course, never leave them without orders under any conditions of good or evil fortune. After this, if the Commandant can spare himself the luxury of a reserve, he must certainly do so, though he must not unduly weaken his active force, or for the matter of that, his passive defense garrisons either. Last, but far from least, there remain for the defense of the batteries themselves the men of the garrison artillery and engineers, who, having their specialist duties to attend to, would hardly be available in the earlier stages to join in the land-side defense, and these can, of course, count on being largely reinforced by the remnants of all the other groups of the defenders.

In a garrison of this description it is impossible to count on having at disposal troops of uniformly equal excellence, and probably there will always be included a large proportion of irregulars. In addition to these, it is to be expected that, on the outbreak of war, the Headquarter Offices will be besieged by men who are too busy in ordinary life to join auxiliary corps, but who would not wish to be idle in case of attack, and for these there must be a good reserve of rifles and practice ammunition, so that the garrison will consist of all kinds of troops, including, one hopes, a nucleus of really good regular infantry. If it can be so arranged, no portion of the work of defense should be left entirely in the hands of unreliable troops, and the various corps should be mixed, some of each taking part in each group of the active and passive defense. This emphasizes the importance of camaraderie and good feeling between all the corps who are associated together in a garrison of this description, and, parenthetically, one hopes that the difficulties of the builders of Babel will not be repeated in any of our very mixed garrisons.

Now, all things considered, one would suppose that if the garrison of the Defended Port has any time to make ready, that is, if the attack does not arrive at a moment of profound peace, and before any special preparations have been begun, the task of the defense, even against considerable odds, should be a fairly easy one. And yet it is a curious fact that this is not borne out by history. If we study the records of attacks from the land side upon Defended Ports in the past, whether in the old wars of the eighteenth and early nineteenth centuries, or in the modern wars of the last few decades, we are bound to confess that in the majority of cases the attack has obtained an easy and often a seemingly quite undeserved success. It is interesting to inquire into the causes which have led to such results. The first cause must undoubtedly be the element of surprise, which attends the arrival of every oversea expedition, and will almost certainly find something unready even in the best-regulated of garrisons. Another cause may be the influence of the crowded civil population, suddenly confronted with the horrors of war, and hardly disposed to offer ready help to the soldiers who have hitherto been working quietly in their midst. The passive tactics of the defense have been to blame in an immense number of cases, but, when one reads of the extremely feeble resistance which has been so often offered in the defense of places of this description, one is bound to lay the blame largely upon the troops and upon their officers.

The defense must not be content with a single fight, even though it may be a good one, and even though they be confronted with enormous odds. They must keep up the resistance with the utmost obstinacy to the last ditch. Every hour's delay adds to the chances of relief and to the difficulties of the attackers. No partial success on the part of the latter should be allowed for a moment to weaken the resistance of the garrison. Many an attack has succeeded when upon the point of being abandoned in despair, and it is want of grit on the part of the defenders which is the chief danger to the safety of the Port. This want of grit must be eradicated by every effort possible in peace training. It should be impressed upon the defenders that they are better off in every way than their opponents; in a friendly country, supported by defenses, and supplied with everything needful, while the invaders are overworked and probably starving, and, if well hunted, will give way under the strain in the course of a very few days, or even hours.
—*The Army Review*, April, 1912.

Short Notes

H. M. S. Lion.—In the *Lion*, the top of the conning tower has been chosen for the fire-control station which is armored. I referred a short time ago to the change in appearance of this ship. The changes that have been made are as follows: The foremost funnel has been shifted back until it is almost close to the amidship one—the funnel positions now being very much the same as those in the *Indomitable* class. The tripod mast, which used to be between the first two funnels, has been dispensed with altogether. The old mainmast has been put just ahead of the foremost funnel, and a bridge built up around it, leaving the conning tower quite clear. Astern of the foremost funnel is a very small mainmast, to carry the derrick. Her three funnels have been greatly increased in height. These changes have undoubtedly increased the efficiency of the vessel.—*The Navy*, June, 1912.

New Super-Dreadnought.—The first keel plate of a new super-Dreadnought, to be named the *Delhi*, was laid down a few days ago at the Naval Construction Works, Barrow-in-Furness. The *Delhi* is of the *Orion* type of battleship, but will contain the many improvements that recent experiences have taught. She will have a displacement of 23,000 tons and a speed of 22 to 23 knots. One of the features of her armament will be an advanced type of 13-inch guns. These will be ten in number, placed in two levels of turrets. They will be able to fire a shell of 1,400 pounds as against 1,250 pounds in the old type of 13.5-inch guns, and will thus be equal to the American 14-inch guns at present fitting in that country to recently launched craft. She will also have sixteen 6-inch guns with a very effective range, capable of dealing with destroyers at great distance. She will be heavily armored and altogether will mark a distinct advance on any super-Dreadnought now afloat.—*Page's Weekly*, June 7, 1912.

A Mine-Laying Squadron.—Every credit should be given to the authorities for the way many of the *Naiad* and *Apollo* class of second-class cruisers have been rescued from those stepping stones to the scrap-heap, the Mother Bank and outpost moorings—and fitted up for a further period of service with the fleet as mine-layers. It has taken some time to complete an efficient squadron of mine-layers in this way, but the British Navy now possesses such a squadron, and one which has no equal in the world. These ships are under the command of specialists, and are frequently exercised at the sort of work they would be called upon to perform in time of war; while they have recently completed a programme which was a searching test of their efficiency for these functions. The test was got through successfully and with credit to all concerned. The vessels have been fitted up at the Royal dockyards as secretly as is possible in these days of many spies and informers, and it is believed that the Admiralty have succeeded in keeping essential knowledge of their equipment from those who are anxious to discover it; it is certain from the facility with which long lines of blockading mines are run that the plan adopted for dropping them is quite reliable. In fairly shallow water, when blockading an emeny's ports or defending our own, such a squadron of mine-layers will be of the utmost utility to an Admiral, especially when manned by crews who have become experts by constant practice in handling them and the intricate machinery with which the mines are well and truly sown along the exact channel it is intended they should be dropped.—*United Service Gazette*, May 30, 1912.

Krupp New 15-Inch Gun.—The Krupp firm in Essen, Germany, has built two new guns which are larger than anything hitherto used in marine or fortification service. The largest of these is a 15-inch gun. The total length of the bore is about 66 feet and the weight of the gun proper is about 226,000 pounds. The weight of the projectile is 1650 pounds, and the gun requires a charge of 690 pounds of powder. The muzzle velocity is slightly over 3100 feet per second, and the energy at the muzzle about 122,000 foot-tons. Close to the muzzle the projectile is capable of penetrating steel plate to a thickness of 4 feet 5 inches.—*Machinery*, June, 1912.

A New Gun.—The Russian horse artillery is now being re-armed with a new gun made by Messrs. Schneider, of Creusot, with a carriage of a type never before employed for field artillery. It has a revolving cranked axletree, so arranged that it is in its lowest position when the gun is fired point-blank, and the overturning strain on the carriage is greatest, and can be turned up when firing at angles of elevation over 17 degrees, when the overturning strain is less. Though the wheels are 4 feet 4 inches in diameter, the height of the axis of the gun is only 31 inches in the low position, and 43 inches in the high position. This novel construction gives a steady carriage with light weight. The gun is a 14½-pounder of 75 millimeters caliber, and muzzle velocity of 1775 f.s., and its weight in action is only 18½ cwt. It has compressed air running-up gear, a panorama sight, and a fuze-setting machine, and is protected by a large curved shield. The new Schneider gun is undoubtedly the best horse-artillery gun as yet adopted by any nation.
—*Army and Navy Gazette*, May 25, 1912.

Fortifications for Canal.—The work of fortifying the Isthmian Canal is under way. Colonel G. W. Goethals is in charge of the preparation of the sites chosen and will have charge of the building of the emplacements, which work will be done with the force he is using in construction work. The plans for the work at Flamenco did not arrive until July, 1911, work being started the following September. In that month the plans for Toro Point and Margarita Point were received and the work is now well under way. At each of the latter points there will be two 14-inch guns and eight mortars; there will also be some 6-inch guns and a battery of 6-inch guns at Colon on the waterfront. Following along the line of the canal the defenses will be land defenses to protect the rear of the coast forts and the various locks, and these defenses will consist of earthworks at some distance from the locks and forts in positions dominating them, to be occupied in case of an investment in force. There will also be defenses in the immediate vicinity of the docks and forts to provide for their coast defense. The land defenses will carry at each end of the canal ten 4.7-inch mortars in fixed positions, and there will also be six mortars of the same caliber, which may be moved to either end of the canal. At the Pacific entrance there will be six 14-inch guns, one 16-inch gun, and twelve mortars. There will also be some 6-inch guns on Culebra Island. It was found necessary to increase the guns on the Pacific side by adding four mortars, two 14-inch guns, and one 16-inch gun to the original estimates. The total estimate of cost covering the entire fortifications is $14,000,000.—*Army and Navy Register*, June 8, 1912.

Continuously Loaded Telephone Cable.—A new loaded submarine telephone cable, which does away with the bulges or thickened places where the loading coils are inserted in the ordinary cables of this type, has recently been laid across the English Channel between Abbotscliff and Cape Gris Nez. The new cable is of the continuously loaded type, the inductance which constitutes the loading being obtained not by coils inserted at intervals, but by a continuous, close helical winding of 0.012 inch steel wire over the copper conductor, the latter being made up of a central wire surrounded by copper tapes. Each conductor thus overwound with steel is covered in the usual way with gutta-percha, and the cable consisting of four of these conductors (making two talking circuits) is laid and armored as is an ordinary cable. The freedom from bulged portions of course facilitates handling and laying, and the cable has met successfully all the attenuation-factor requirements.—*Scientific American*, May 11, 1912.

NOTICES

BUREAU OF MINES' PUBLICATIONS FOR FREE DISTRIBUTION

We have been asked to print the following:

DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

New Publications

Bulletins. (List 10.—May, 1912.)

Bulletin 36. Alaskan coal problems, by W. L. Fisher. 1912. 32 pp. 1 pl.

Technical Papers

Technical Paper 12. The behavior of nitroglycerin when heated, by W. O. Snelling. 1912. 14 pp. 1 pl.

Technical Paper 13. Gas analysis as an aid in fighting mine fires, by G. A. Burrell. 1912. 16 pp.

Technical Paper 16. The deterioration and spontaneous combustion of coal in storage, by H. C. Porter and F. K. Ovitz. 1912. 14 pp.

Miner's Circular

Miner's Circular 6. Permissible explosives tested prior to January 1, 1912, and precautions to be observed in their use, by Clarence Hall. 1912. 20 pp.

Reprint

Bulletin 37. Comparative tests of run-of-mine and briquetted coal on locomotives including torpedo-boat tests and some foreign specifications for briquetted fuel, by W. F. M. Goss. Reprint of the United States Geological Survey Bulletin 363. 58 pp. 4 pls.

Bulletin. (List 11.—June, 1912.)

Bulletin 41. Government coal purchases under specifications with analyses for the fiscal year 1909-10, by G. S. Pope, with a chapter on the fuel-inspection laboratory of the Bureau of Mines, by J. D. Davis. 1912. 97 pp. 3 pls.

Technical Papers

Technical Paper 5. The constituents of coal soluble in phenol, by J. C. W. Frazer and E. J. Hoffman. 1912. 20 pp.

Technical Paper 9. The status of the gas producer and of the internal-combustion engine in the utilization of fuels, by R. H. Fernald. 1912. 42 pp.

Technical Paper 19. The factor of safety in mine electrical installations, by H. H. Clark. 1912. 14 pp.

Technical Paper 20. The slagging type of gas producer, with a brief report of preliminary tests, by C. D. Smith. 1912. 14 pp.

Reprint

Bulletin 39. The smoke problem at boiler plants, a preliminary report, by D. T. Randall. 31 pp. Reprint of United States Geological Survey Bulletin 334, revised by S. B. Flagg.

The Bureau of Mines has copies of these publications for free distribution, but can not give more than one copy of the same bulletin to one person. Requests for all papers can not be granted without satisfactory reason. In asking for publications please order them by number and title. Applications should be addressed to the Director of the Bureau of Mines, Washington, D.C.

MILITARY INVENTIONS

Arrangements have been made with H. B. Willson & Co., Patent At- ys, 715 Eighth St., N. W., Washington, D. C., to furnish us lists of s of interest from a military point of view. These will appear in each issue of the JOURNAL hereafter, if they seem to be of sufficient interest to our readers to pay for the space used. Give number of patent and enclose 10 cents to Willson & Co., for complete copy of any patent in which you are interested.

AERONAUTICS

1,028,865	Flying Machine, Vito Ettore D'Urso, New York, N. Y.
1,028,887	Aeroplane, H. J. Kraft, Chicago, Ill.
1,028,891	Airship, W. D. LeFevre, Dover, Del.
1,028,968	Aeroplane, L. R. Rooney, Hollidaysburg, Pa.
1,028,971	Flying Machine, M. L. Shackleford, Oatman, Ariz.
1,028,981	Flying Machine, J. W. Wilson, Boston, Mass.
1,029,010	Kite, H. P. Guillo, Revere, Mass., Assignor to Forbes Lithograph Mfg. Co., Boston, Mass.
1,029,057	Propeller for Air or Water Craft, Adolph Finch, San Diego, Cal., Assignor to A. B. Bowman, San Diego, Cal.
1,029,475	Safety Appliance for Flying Machines, L. W. Stolp, Washington, D.C.
1,029,529	Airship, J. F. Bradshaw, near Overton, Texas.
1,030,942	Aeroplane; J. C. Telfer, Spokane, Washington.
1,030,968	Stabilizing Aeroplanes, Emile Bourdelles, Paris, France.
1,030,994	Flying Machine, Pasquale Giordano, Boston, Mass.
1,031,148	Automatically-Deformable Balloon, Attilio Ranza, Rome, Italy.
1,031,230	Airship, J. W. Batdorf, San Jose, Cal.
1,031,452	Wing for Flying Machines, George Korf, Hamburg, Germany.
1,031,461	Airship, J. P. Olsen, Jr., Salt Lake City, Utah.
1,031,569	Flying Machine, Henry Miller, Washington, Penn.
1,031,597	Airship, J. N. Thompson, New Madrid, Mo.
1,031,623	Propelling Mechanism for Aerocraft, M. F. DeRedon, DeColombier, Paris, France.
1,030,312	Aeroplane, Henry Laprise, Holyoke, Mass.
1,030,363	Aerostructural Balance, F. E. Whitlatch, Windsor, Ill.
1,030,518	Aeroplane, J. R. Machado, Vallejo, Cal.
1,030,542	Aeroplane, J. T. Rydberg, Garwood, N. J.
1,030,764	Aeroplane, L. F. Bancroft, Hartford, Conn.
1,030,772	Aeroplane, D. R. Davis, Eau Claire, Wis.
1,030,803	Flying Machine, Sydney Borman, Attleboro, Mass.
1,030,826	Airship, Anton Mayer, Chicago, Ill.
1,032,587	Aeroplane, S. M. Brown, Portland, Oregon.
1,032,651	Apparatus for Testing Flying Machines, Frederick Brackett, Washington, D. C.
1,032,699	Aerial Vessel, C. J. Payne, Philadelphia, Pa.
1,032,729	Propeller-Blade for Aeroplanes, J. W. Baker, Pittsburgh, Pa.
1,032,744	Flying Machine, L. S. Cunningham, Clinton, Wash.
1,032,812	Flying Machine, John Casap, New York, N. Y.
1,032,825	Automatic Stabilizing Apparatus for Aeroplanes, G. W. Muller, Philadelphia, Pa.
1,032,868	Flying Machine, G. E. Thompson, Pittsburgh, Pa.
1,032,966	Aerial Vehicle, Michael Todisco, Brooklyn, N. Y.
1,032,967	Flying Machine, Leon Troxler, New Orleans, La.
1,032,968	Wireless Means for Controlling Aeroplanes, C. L. Vanderburg, Hutchinson, Kans., Assignor to H. A. Vanderburg, Hutchinson, Kans.

1,032,976	Flying Machine, Jens Wulff, Erwin, S. D.
1,031,705	Air-Car or Airship, Wm. Friese-Greene, Brighton, England.
1,031,797	Aeroplane, J. M. Janesone, Richmond Hill, N. Y.
1,031,807	Air-Navigating Machine, Ernest Molnar, Cleveland, Ohio.
1,031,840	Flying Machine, A. I. Crenshaw, Chicago, Ill.
1,031,904	Airship, B. M. Beskow, New York, N. Y., Assignor to C. S. Champion, Brooklyn, N. Y.
1,032,050	Aerial Propeller, Harry Houlette Elliott, Lawrence, Kansas.
1,032,093	Aerial Machine, W. E. J. Vavasour, London, England.
1,032,162	Aeroplane Propelling Wheel, N. G. Sorecen, Chicago, Ill.
1,032,233	Stability Device, Francis Nyilas, New York, N. Y.
1,029,754	Aeroplane, J. R. Hendrickson, Edmonton, Alberta, Canada.
1,029,776	Propelling Device for Water and Air Vessels, A. W. VanDeursen, Nimvegen, Netherlands.
1,028,120	Flying Machine, L. A. Leech, Carnegie, Pa.
1,028,143	Aeroplane, W. B. Shepard, Beloit, Wis.
1,028,336	Stabilizing Device for Flying Machines, Wilhelm Duchting, Berlin, Germany, Assignor to Paul Rath, Major, Krakau, Ger.
1,028,409	Aeroplane, C. B. Westerman, Columbia, Pa.
1,028,502	Aeroplane Sighting Device, F. L. Slack, Inglewood, Cal.
1,028,517	Parachute, C. L. Willard, Denver, Colo.
1,028,765	Airship-Propeller, R. H. Milton, Greensboro, N. C.
1,028,781	Flying Machine, W. J. Purvis and C. A. Wilson, Goodland, Kans.
1,028,782	Automatic Stabilizer for Flying Machines, Max Raabe, Cornberg in the Taunus, Germany.
1,027,572	Aeroplane, J. W. Silver, South Tacoma, Wash., Assignor to C. P. Savage, Tacoma, Wash.
1,027,590	Dirigible Airship, Ernst Bucher, Heidelberg, Germany.
1,027,764	Aviator-Protector, Francois Rilleau, Los Angeles, Cal.
1,027,954	Aeroplane, J. A. Williams, Cleveland, O.
1,027,990	Airship, B. C. Cole, Marshall, Wyo.
1,028,010	Aerial Trolley, J. W. Fawkes, and E. E. Fawkes, Burbank, Cal.
1,028,071	Equipoiser, Geo. Hipwood and Patrick Egan, New York, N. Y.
1,026,677	Aeroplane, T. H. Keppel and R. F. Keppel, St. Louis, Mo., and J. E. Kipper, Jr., Indianapolis, Ind.
1,026,959	Airship, J. T. Long, Encanto, Cal.
1,027,242	Means for Launching Flying Machines, G. H. Curtiss, Hammondsport, N. Y.
1,027,252	Mounting of Aerial Propellers, R. J. Isaacson, Leeds, England.
1,027,258	Flying Machines, John Kubish, Indian Orchard, Mass.
1,027,322	Flying Machine, D. V. Cole, Los Angeles, Cal.
1,027,372	Flying Machines, M. M. Benster, Gettysburg, S. D.

ARTILLERY

1,028,081	Liquid Recoil-Brake for Guns, Karl Voller, Dusseldorf, Germany, Assignor to Rheinishe Metallwaaren und Maschinenfabrik, Dusseldorf, Dorendorf, Germany.
1,028,939	Fluid-Brake for Recoil-Guns, Walter Heilemann, Essen-on-the-Ruhr, Germany, Assignor to Fried. Krupp Aktiengesellachaft, Essen-on-the-Ruhr, Germany.

1,030,087	Safety Firing Attachment for Breech-Loading Rifles, Frederick Hartney, Higginsville, Mo.

AUTOMOBILES

1,031,723	Variable Speed Mechanism for Motor-Vehicles, Thos. Lumsden, Gateshead, England.
1,032,003	Transmission Mechanism for Automobiles, E. M. Heylma, Janesville, Wis.
1,032,120	Propeller for Automobile Sleighs, M. A. Jean De La Besse, Paris, France.
1,032,185	Signalling Device for Automobiles, E. T. Burrowes, Portland, Me.
1,032,309	Head-light Adjuster for Motor Vehicles, P. N. Squires, Canon City, Colo.
1,032,350	Transmission-Gearing for Automobile Vehicles, Gustave Dumont, Neuilly-sur-Seine, France.
42,732	(Design), Automobile Body, G. W. Dunham, Detroit, Mich., Assignor to Chalmers Motor Co., Detroit, Mich.
42,738	(Design), Automobile Body, O. P. Fritchle, Denver, Colo., Assignor to Fritchle Automobile and Battery Co., Denver, Colo.
1,032,757	Dual-Tire Wheel for Autotrucks, Phineas Jones, Metuchen, N. J.
1,032,517	Motor-Vehicle, V. V. Torbensen, Bloomfield, N. J., Assignor to Torbensen Gear and Axle Co., Bloomfield, N. J.
1,032,607	Supporting Device for Automobiles, E. M. Ingalls, Newburyport, Mass.
1,032,633	Motor-Car, C. B. Stebbins, Three Rivers, Mich., Assignor to Sheffield Car Co., Three Rivers, Mich.
1,032,924	Vehicle-Headlight, W. M. Kinney, Crows Landing, Cal.
1,032,934	Controlling Mechanism for Motor-Vehicles, B. J. Patrick, Brookfield, Mo.
1,032,955	Puncture-Proof Inner Casing for Pneumatic Tires, T. F. Shiels, and W. R. Bolter, Lowell, Mich.
1,032,975	Automobile-Elevator, B. F. Wilson, Hastings, Neb.
1,032,454	Shock-Absorber, R. T. Wainright, Rye, N. Y.
1,032,857	Wind-Shield for Automobiles, W. A. Pearson, Troy, Ohio.
1,032,903	Automobile-Driving Gear, John Hettrich, Lincoln, Neb.
1,029,303	Gun to be Mounted upon Automobiles, Norbert Koch, Essen-Rellinghausen, Germany, Assignor to Fried Krupp Aktiengesellschaft, Essen-on-the-Ruhr, Germany.
1,032,659	Tire-Holder, J. C. Cole, Chicopee Falls, Mass., Assignor to the Fisk Rubber Co., Chicopee Falls, Mass.
1,032,690	Automobile Buffer, A. L. McGregor, Chicago, Ill.

ENGINES

1,032,004	Engine-Starter for Automobiles, W. S. Grigsby, Denver, Colo.
1,032,794	Exhaust-Silencer for Internal-Combustion Engines, F. E. Wolf, Nowawes, near Potsdam, Germany.
1,031,908	Starting Device for Explosive Engines, J. A. Brown and C. G. Bosch, Cedar Rapids, Iowa, Assignors to Bosch-Rhea Co., Cedar Rapids, Iowa.

1,032,516	Engine-Starter, W. L. Stuller, Detroit, Mich., Assignor to G. W. Soules, E. C. Campan, T. R. Bell and W. H. Soules, Detroit, Mich.
1,032,584	Engine-Starter, E. A. Bostrom, Atlanta, Ga.
1,032,694	Engine-Starting Device, C. A. Milne, Wm. Taylor and M. R. Churchill, Detroit, Mich., Assignors to Motor Appliance Co., Detroit, Mich.
1,032,536	Apparatus Purifying the Exhaust of Internal-Combustion Engines, Paul Gerli and Guido Blenio, New York, N. Y.

EXPLOSIVES

1,028,950	Explosive, J. F. O'Brien, Chicago, Ill.
1,028,951	Explosive, J. F. O'Brien, Chicago, Ill.
1,028,952	Explosive, J. F. O'Brien, Chicago, Ill.
1,029,519	Method of Making Unfreezable Explosives, Vezio Vender, Milan, Italy.

INSTRUCTION AND PRACTICE DEVICES

1,031,566	Device for Practicing in Shooting Without Projectiles, Giuseppe Menariri and Attilio Emanuele, Rome, Italy.

PROJECTILES, ETC.

1,027,964	Projectile, O. A. Yingling, Washington, D. C.
1,027,243	Means for Securing Caps for Projectiles, Thomas Dixon, Washington, D. C., Assignor to Washington Steel and Ordnance Co., Washington, D. C.
1,029,517	Projectile for Ordnance, Henry Stanbridge, Tinsley, near Sheffield, England, Assignor to Joseph Albert Hill, Sheffield, Eng.
1,031,320	Projectile, J. H. Brown, West Hoboken, N. J.

RANGE FINDERS

1,030,846	Range-Finder, A. A. Michelson, Chicago, Ill.
1,031,279	Combined Multibarrel Gun and Range-Finder, Hudson Maxim, Brooklyn, N. Y.

SHIPS (NAVAL), ARMOR, ETC.

1,028,472	War Vessel, Hudson Maxim, New York, N. Y.
1,028,473	Torpedo-Boat, Hudson Maxim, Hopatsong, Borough, N. J.

SIGHTS, ETC.

1,026,660	Sighting Apparatus for Ordnance, A. T. Dawson and G. T. Buckham, Westminster, London, England.
1,028,917	Sighting Device for Machine Guns and the Like, Boris Svistounoff, St. Petersburg, Russia.
1,027,891	Rear Gun-Sight, G. W. Peck, Jr., and W. M. Farrow, Sr., Washington, D. C.
1,027,892	Front Gun-Sight, G. W. Peck, Jr., and W. M. Farrow, Sr., Washington, D. C.
1,029,951	Night-Sight for Firearms, G. A. Seely, San Francisco, Cal., Assignor to J. Salsbury, San Francisco, Cal.
1,030,070	Telescopic Sight for Ordnance, Otto Forstman, Jena, Germany, Assignor to the Firm of Carl Zeiss, Jena, Germany.
1,027,271	Sight for Rifles and Machine Guns, Emil Muller, Dusseldorf, Ger.

1,029,292	Ventilated Sighting-Rib for Guns, F. O. Hoagland, Bridgeport, Conn., Assignor to Remington Arms and Ammunition Co., Ilion, N. Y.
1,028,219	Gun-Sight, J. R. Jones, Westernville, N. Y.

SMALL ARMS, TARGETS, ETC.

1,031,373	Firearm, E. E. Redfield, Glendale, Ore.
1,031,374	Firearm, E. E. Redfield, Glendale, Ore.
1,031,428	Magazine-Gun, F. D. Ubaldo, New York, N. Y., Assignor to John Rumore, New York, N. Y.
1,029,374	Fore-Arm Lock for Guns, J. C. Kremer and A. H. Fox, Philadelphia, Pa., Assignors to A. H. Fox Gun Co., Philadelphia, Pa.
1,028,884	Automatic Firearm, Ivar Johnson, Redlands, Cal., Assignor to C. E. Ide, Redlands, Cal.
1,031,221	Combined Molding and Loading Tool, J. R. Wilson, Hartranft, Tenn., Assignor to R. L. Hoskins, Fort Ridge, Tenn.
1,031,644	Cartridge-Loading Machine, H. P. Hall, New York, N. Y., Assignor to E. I. DuPont de Nemours Powder Co., Wilmington, Del.
1,029,037	Firearm, C. A. Young, Near Enon, Ohio.
1,029,229	Hand-Firearm, F. T. Russell, Philadelphia, Pa., Assignor to A. H. Fox, Gun Co., Philadelphia, Pa.
1,027,371	Target, B. W. Bates and A. T. C. Hale, Birmingham, England.
1,027,509	Cartridge-Blank Receiver, L. R. Smiley, Braddyville, Iowa.
1,027,556	Attachment for Pistols, J. A. Garth, Marshall, London, Eng.
1,027,773	Firearm, B. H. Savage, Duarte, Cal., Assignor to Sears, Roebuck, and Co., Chicago, Ill.
1,027,814	Priming Mixture, W. H. Buell, New Haven, Conn., Assignor to Winchester Repeating Arms Co., New Haven, Conn.
1,027,893	Firearm, G. W. Peck, Jr., and W. M. Farrow, Sr., Washington, D. C.
1,029,720	Automatic Firearm, N. C. Schellenger, Salt Lake City, Utah.
1,029,781	Firearm, A. H. Worrest, Lancaster, Pa.
1,029,782	Single-Trigger Mechanism for Double-Barrel Guns, A. H. Worrest, Lancaster, Pa.
1,028,032	Automatic Repeating Firearm, O. H. J. Krag, Ullern, near Christiania, Norway.

SUBMARINE MINES AND TORPEDOES

1,030,134	Automatic Steering Device for Torpedoes, H. W. Shonnard, East Orange, N. J.
1,032,394	Method of and Apparatus for Delivering Submarine Torpedoes from Airships, B. A. Fiske, U. S. Navy.

MISCELLANEOUS

1,028,141	Inflatable Life-Saving Equipment for Soldiers, E. W. Scowden, Jamestown, N. Y.
1,032,730	Elastic Wheel, H. G. Baldwin, San Francisco, Cal.
1,029,630	Method of and Apparatus for Charging Powder, W. H. Plummer, and John Tresider, Coleraine, Minn.

BOOK REVIEWS

All the World's Aircraft. By F. T. Jane. England, London: Sampson Low, Martson & Company, Ltd., 100 Southwark Street. 8" x 12¾" 408 pp. Numerous cuts, sketches and plans. 1912. Price, 21 shillings, net.

Part I describes the air-craft of the world. Those for each nation are listed separately and the lists are alphabetically arranged.

The description of each machine gives its principal dimensions and characteristics, and is in most cases effectively supplemented by cuts and sketches. The data collected are important to any student of aeronautics.

For each nation there is also given a list of aviation and aero clubs.

The arrangement of Part I is excellent, and places a description of the general methods of present aeronautical construction in a convenient form. The data given for each machine would be of increased value, if the speed of the motor and the pitch of the propellor were included.

Part II describes the world's aerial engines. The lists are arranged as in Part I and the principal features and dimensions are shown.

The value of this part would be greatly increased if the notes gave some account of actual performances and rated the efficiency of the engines, and, where propellors are included, the total efficiency of the plant.

Part III is an aerial "who's who" and trade directory. It is conveniently arranged and appear to be complete.

Applied Minor Tactics. Including Map Problems and the War Game. By Captain James A. Moss, 24th U. S. Infantry. Sales Agents: U. S. Infantry Association, Washington, D. C.; U. S. Cavalry Association, Fort Leavenworth, Kansas; Post Exchange, Fort William McKinley, P. I. 5½" x 7¾". 178 pp. 31 il. 3 pocket maps. Cloth. 1912. Price, $1.50.

This book of about 180 pages contains no preface nor introduction save for the remark on the title page explaining that it is "Especially Adapted to the Instruction of Noncommissioned Officers and Privates in their Duties in Campaign." For this purpose it will undoubtedly prove valuable. Uniformity in methods of instruction is of great importance to the army. The spirit of the Infantry Drill Regulations, 1911, pervades the pages of this book and the applicatory methods of instruction which have been so thoroughly developed at the Fort Leavenworth schools are now passed down to the noncommissioned officer.

Much of the matter and many of the prints will be recognized by those familiar with the work at these schools. It is regretted that the price could not have been made such as to allow a wider circulation among those for whom it is intended.

The subjects of the seven chapters are as follows:

I. Map reading, pp. 1 to 29.

II. General Common Sense Principles of Applied Minor Tactics, pp. 30 to 35.

III. General Plan of Instruction in Map Problems for Noncommissioned Officers and Privates, by Squad, Section, Platoon, pp. 36 to 41.

IV. The Source of Information, pp. 42 to 82.

V. The Source of Security, pp. 82 to 135.

VI. The War Game and Map Maneuvers, pp. 136 to 164.

VII. Military Sketching, pp. 165 to 178.

Electrical Injuries, Their Causation, Prevention and Treatment. Designed for the Use of Practical Electrical Men. By C. A. Lauffer, A. M., M. D. New York: John Wiley & Sons; London: Chapman & Hall, Ltd. 4" x 6½". vi + 77 pp. 1 il. 1912. Price, 50c net.

A complete and interesting account of the various electrical injuries is given followed by an admirable description of the most modern treatment in a form which can be readily comprehended and remembered by the average reader.

The subject of resuscitation is especially well handled and constitutes one of the clearest and best presentations of the subject that has appeared in recent first aid works.

The chapters on minor surgery, first aid, and infections are also excellent, but considering their importance might be treated in more detail.

The chapter entitled "Effects of Occupation on Health" is a condensation of the matter usually covered in popular articles on personal hygiene.

The value of the book is increased by a series of questions on the subjects of which it treats.

"Tin Soldiers." The Organized Militia and What It Really Is. By W. M. Pratt. Boston, Mass.: Richard G. Badger, The Gorham Press, 194 Boylston Street. 5½" x 8". 185 pp. 16 il. Cloth. 1912. Price, $1.50, net.

"Tin Soldiers" is not a study, neither is it a work, but rather the expressions and feelings of a militiaman who has his heart in his own pet hobby and what he has to say is worth reading and what he thinks is logical and much to the point.

We all admit that the one great ailment of the militia is lack of spirit and enthusiasm in its work and we all know that to be an ardent militiaman one must necessarily sacrifice time, money, and in many cases the only vacation that is within reach. So, when we meet a good militiaman we know that he is not only a good soldier but a man who gives up many of the pleasures of this life to perform an important duty for which he is little thanked. Almost anything that we attempt is uphill, but there is generally someone to help along. In militia work one is working uphill all the time, and at times it seems as if no one cares whether he succeed or not.

The author has evidently had more than the usual amount of experience in practical militia matters and has been able to grasp the situation from all sides. There are many interesting facts regarding the militia which, possibly, we have not thought of before. Mr. Pratt places them before us in a pleasing way and one cannot help but be interested in his viewpoint. He talks of militia maneuvers, strike duty and the mobile army. The strike duty in Lawrence, Mass., is well detailed. And there is a plea for the Federal Pay Bill.

The substance of Mr. Pratt's little book may be briefly stated in these few words: If the American people will not allow their army to be increased then they must depend on the militia; so let them not be prone to criticize and ridicule, but rather let them encourage, in order that the militia may become, with the regular army, a guarantee of peace at home and abroad. It is hoped that more efforts along this line will follow.

Field Service. Second Edition, Revised and Enlarged. By Captain James A. Moss, 24th U. S. Infantry. Sales Agents: U. S. Infantry Association, Washington, D. C.; U. S. Cavalry Association, Fort Leavenworth, Kansas; Post Exchange, Fort William McKinley, P. I. 5½" x 8" 166 pp. il. Cloth. 1912. Price, $1.25.

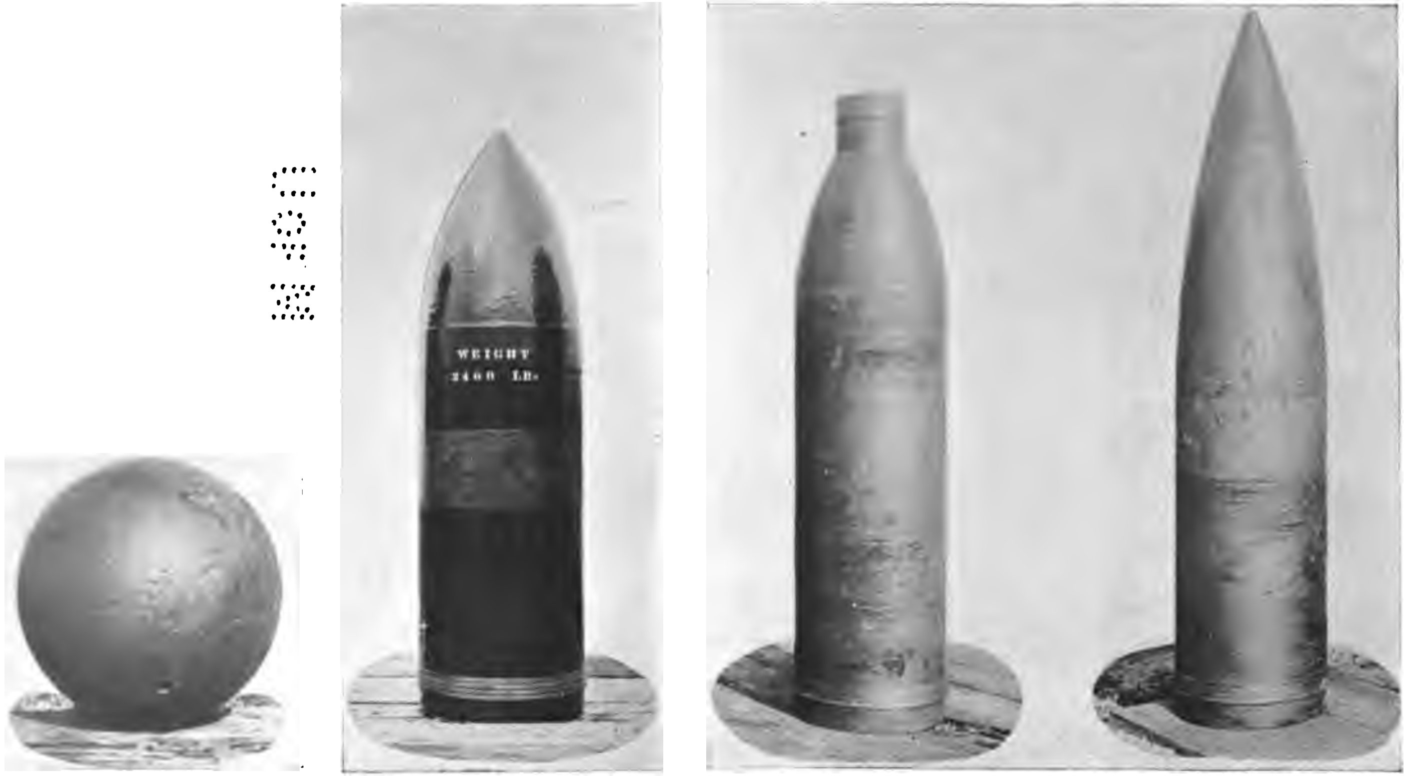
Information concerning equipment for field service and regulations on the subject are much scattered in our army publications. Captain Moss's book on Field Service is a very good compilation of current information on this subject and covers many points in addition to such as are included in the various manuals.

The first edition of this book published by the Warnock Uniform Co., about ten years ago contained but 80 pages 4" x 7". The present edition is much more thorough in its treatment of the subject and contains 166 pages 5½" x 8".

The following gives the titles of the fourteen chapters:

Chapter I. Equipment and Personal Effects of Officers.
II. Equipment and Personal Effects of Enlisted Men.
III. A Company Taking the Field.
IV. Loading Wagons.
V. Transportation and Caring for Means of Transportation.
VI. Marches.
VII. Camping.
VIII. Camp Expedients.
IX. Individual Cooking.
X. Field Cooking.
XI. Field Baking and Field Baking Equipment.
XII. Care of the Health and First Aid to the Sick and Injured.
XIII. Rifle Trenches.
XIV. Miscellaneous.

Frontispiece



EVOLUTION OF THE PROJECTILE IN EXTERIOR FORM 1169

1. Spherical Shell, 20-Inch; 2. Ogival Shell, 16-Inch; 3. Ogival Shell with Early Cap, 12-Inch; 4. Modern Shell with Long-Pointed Cap, 12-Inch

JOURNAL
OF THE
UNITED STATES ARTILLERY

*"La guerre est un métier pour les ignorans
et une Science pour les habiles gens."*

VOL. 38 No. 2 SEPTEMBER—OCTOBER, 1912 WHOLE No. 117

FOREWORD

The JOURNAL OF THE UNITED STATES ARTILLERY having been established in 1892, the year 1912 has seen the completion of a fifth of a century of its career. Accordingly, a survey of the progress made in the various departments of the coast artillery arm of the service during the JOURNAL's life, has been thought appropriate, and has been so far carried to completion that the JOURNAL is now in possession of a number of most interesting articles setting forth the development of modern coast defense in the United States.

Originally, the intention was to publish all of the articles in a single anniversary number; but circumstances prevented that. Then it was thought that they might be presented to the readers of the JOURNAL in two numbers. But now it appears most expedient that the information contained in them be presented serially.

The most cogent reason for this decision is that, the interval between issues of the JOURNAL being two months, devoting two numbers to historical articles only would cause too long a postponement of the publication of articles appropriate to the hour. Then, too, suspending subordinate departments of the JOURNAL for so long a time would have its disadvantages.

Therefore, beginning with this number, the JOURNAL will present to its readers a series of articles in which is reviewed the history of the JOURNAL OF THE UNITED STATES ARTILLERY and the progress made in the United States between 1892 and 1912 in the several branches of coast defense.

Besides the history of the JOURNAL related by its four former editors, the individual articles treat of:

1. Guns and Carriages.
2. Powders, Projectiles, Fuzes, and Primers.
3. Gunnery.
4. Fire Control.
5. Target Practice.
6. Submarine Mining.
7. Organization.
8. Tactics.
9. Armor and Ships.
10. Land Defense.

They may not, however, be presented in the order stated.

THE EDITOR.

THE JOURNAL OF THE U. S. ARTILLERY

By Colonel JOHN W. RUCKMAN, Coast Artillery Corps

I. Its Origin and Purpose

The Journal was founded in 1892, and evolved from the demands of necessity. To those now in the Corps whose memories and experience run back to, or beyond this date, historical remarks will be superfluous; but in the Artillery today are many whose military careers started long since the Journal's beginning, and to whom a glance at the earlier days will be interesting and instructive.

In those days no foreign people knew that the United States had such a thing as artillery, and, our own people knowing but little more, it really would not have been safe to insist on the point too strongly. Artillery sentiment was an absent quantity.

The first public sign of activity in this arm came to the surface in 1887 when the Artillery Council met at Governor's Island, New York. The Council consisted of two officers selected from each regiment, and at its meetings questions of organization, equipment and promotion were discussed and its conclusions were published in the form of reports, but no direct nor immediate results followed. The Council was, however, at least an indication of an awakening from the long, death-like sleep apparent up to that time and must have influenced subsequent events; for efforts once or twice afterward were made to establish an artillery association, which though unsuccessful and followed by another period of rest, evidently heralded the advent of artillery activity, and emphasized the need of a medium for the exchange of ideas. Out of the recognition of that need, which, having once dawned, kept on growing, developed the Journal.

In the fall of 1891 active steps were taken by a few officers at Fort Monroe to produce a magazine which should satisfy the requirements of the service; and through their efforts, and favorable circumstances, the Journal came to life.

In the brief statement which follows it would be impossible to record all the antecedent conditions and incidents which led up to and formed the background of this "Red Review." At that time the five regiments of Artillery contained two hundred and eighty officers; now there are seven hundred in the Coast Artillery Corps, of whom but eight per cent were in the service at the time in question. And since the future welfare of the Corps must depend largely upon the zeal and character of the ninety-two per cent, it is to this element in particular that these remarks are addressed.

II. Questions of Ways and Means

The decision having been reached that a publication was necessary, ways to accomplish the object and the means available were discussed; and both were found to be vanishingly few, for the arm was small and by no means united.

Several schemes were suggested, of which but one seemed to offer any chance of success, and even that was doubtful. It was imperative that the cost should be kept down to a minimum, which could be accomplished only by publishing the paper at the Artillery School; while to that proposition was the objection that independence of action and speech would be restricted by the school authorities, and the publication thereby rendered useless and a failure. On the other hand, by such a course would be secured many substantial advantages which far outweighed the possible drawback just mentioned. These were: convenience, stamp of official approval, location at the center of artillery activity, and above all, cheapness. And the fear of restriction proved to be wholly imaginary, for the only case in which the question of printing an article on account of its being too critical did arise, was decided affirmatively by the Commandant, who thus showed himself to be a broad minded man. Time was to prove that the officers who had the welfare of the school in their hands also labored for the good of the service, and always pursued a liberal policy towards the Journal.

The next question was that of funds. The best plan seemed to be for those interested to write personal letters to friends and acquaintances at artillery posts, stating definitely the terms of the project, and asking each if he was willing to contribute two dollars and fifty cents. That was done, and the answers were generally very gratifying, it being found, when the returns were in, that one hundred and sixty had pledged themselves, thereby assuring four hundred dollars for the first year. That paid for the first volume, and as the total receipts for the period included exceeded this by one hundred and twenty-five dollars, a sufficient balance was available for the beginning of the second year. With these data, Lieutenant Willcox, now professor at the Military Academy, and the writer, visited the Commandant of the School, Colonel Royal T. Frank, at his house and outlined a plan of procedure. At first he wished to call the officers together for a general discussion, but was persuaded to proceed to business. A general discussion at a meeting of officers at that time would certainly have killed the scheme and have postponed action several years. When he was informed that manuscript for the first number was on hand, he said, "Turn it in, and we will start." It was turned in, and work began early in December.

III. ORGANIZATION AND GOVERNMENT

Up to this stage no method of directing the work through a suitable organization had been attempted. But the project was now ready for execution and some method of directing it had become imperative, if the work was to be carried on in a continuous and stable manner. So, as time just then was precious and further delay inadvisable, to pass this difficulty, the Commandant of the School designated the following officers stationed at the post, namely:

1st Lieutenant William B. Homer, 5th Artillery,
1st Lieutenant Henry C. Davis, 3rd Artillery,
1st Lieutenant Cornelis De W. Willcox, 2nd Artillery,

2nd Lieutenant Lucien G. Berry, 4th Artillery, and the writer, from the 1st Artillery, as a tentative committee for the first year. The duties of the committee were to look after any question that might demand attention. Some of these proceedings, viewed from the standpoint of twenty years after, may appear arbitrary or revolutionary, but they were necessary to eliminate extended and useless controversies under circumstances demanding prompt and decisive action.

The Commandant from the start rightfully insisted that a publication emanating from the school should be supervised by the School Board which would thereby become sponsor for its character.

By the end of the first year the JOURNAL was so well started that the need of a stable organization was urgent. The subscribers also had rights in the matter which should be guarded by a committee of general direction and publication. The members of this committee were officers who were willing to serve, were chosen by the Commandant of the School, and consisted of:

Colonel Henry W. Closson, 4th Artillery,
Captain James M. Ingalls, 1st Artillery,
Captain E. L. Zalinski, 5th Artillery,
1st Lieutenant Erasmus M. Weaver, 2nd Artillery,
1st Lieutenant George Owen Squier, 3rd Artillery.

The names of these officers are well known in the Artillery Corps and it is evident that with them as the guiding spirits in the new venture and at the helm, things could not go very far wrong. In practical application this arrangement was simple, flexible, and strong, served its purpose well and was a potent factor in the JOURNAL's success.

During the first four years, owing to the number of questions demanding attention, the editor was never at a loss for timely subjects to push to the front and in that respect his duty was always clear. With a little care, questions which were likely to come up were easily anticipated and by correspondence and personal interviews with members of this committee the necessity for formal reference of any subject thereto was entirely obviated. The first copy, or number, was completed and distributed on February 19, 1892. Col. Frank took a keen interest in the production of this number and was highly gratified at the result. In printing, the chief printer laid aside the first sheet of each folio and these were bound up into proper form and the pamphlet was presented to Colonel Frank by Lieutenant Willcox and the writer, with a brief statement of its origin. He was highly pleased at this slight but well-merited attention. This practice was continued throughout the next four years.

It is proper to say here that during nearly seven years' connection with the JOURNAL Colonel Frank's zeal for its welfare never weakened, and as years went on, his gratification at its success and widening reputation increased accordingly. No request within his power to grant that would add to its character, influence, or further progress, was ever refused, and it is now a pleasure to recite these facts and place them on record to his credit.

It is also in order here to acknowledge obligations to the Adjutant of the School, 1st Lieutenant Edward Davis, 3rd Artillery, now brigadier-general, retired, for his ever kind and obliging attitude towards the work.

In this connection the sympathetic and encouraging disposition of the majority of the older officers must not be forgotten. They at least contributed their money and best wishes to the cause. Active opposition, which arose at times, came not from them but from younger ones with energy and advanced ideas. These references to the former are placed on record here, in partial recognition of the great obligation due them from the artillery arm—an obligation now in danger of being forgotten. Were space available it would be appropriate to insert a list of their names, and the many ways in which they showed their loyalty, which always arose from that affectionate regard which the old soldier has for the future welfare of his corps. The swords of many of them have done their last service and have been sheathed and hung upon the wall, but their influence still lives in our ideals. The new Artillery should not forget them.

During the first years of the development of the JOURNAL, human nature appeared to be always on parade. There were many who could explain precisely how everything should be done but who never did anything. Some were afraid of injuring other military magazines, and others there were who bought each number as it was issued, thereby avoiding the risk of losing a portion of the subscription price by failure. Some said they would not subscribe but did so later, and others said they would, but never paid the money. Success finally brought in many of the "dissenters," and later some of them became so ardent that one not acquainted with the circumstances might have thought that they had originated, and in fact owned, the whole affair.

1st Lieutenant Charles B. Satterlee, 3rd Artillery, when addressed concerning the plan to publish a magazine, immediately forwarded his year's subscription, months before the details had been arranged, and thereby became the first subscriber. He showed his willingness to risk a small amount, even though the outcome was by no means certain.

IV. SCOPE AND POLICY

In dealing with artillery subjects, it was advisable to define the scope and policy of the new publication. In those days great problems were in the foreground; they could not be evaded; and it was necessary to give them attention in proportion to their importance. All questions were included under one of the following heads:

1. Organization,
2. Instruction,
3. Material.

The first being most urgent and important took precedence over all others, and whenever possible had first place in the book. The heavy blows delivered repeatedly against existing conditions, in time did their work; the question of organization was solved.

Instruction was constantly under discussion. Number 11 was entirely composed of contributions from officers who had replied to a circular letter asking them to submit their ideas. The distribution of this number caused such interest in artillery practice that in the season of 1894 the hitting capacity of the batteries increased almost beyond belief, and improvement continued during succeeding years. Artillery instruction has not yet reached a satisfactory status. Old problems have been solved, but new and more difficult ones are arising, requiring united and continuous effort. Unlike matters of organization, those which come up under instruction rest wholly with the Artillery. The artillery material now available for purposes of instruction is so superior to that of early times that former considerations relative thereto are no longer vital to continued development.

The improvement in the Coast Artillery, viewed from the present in comparison with twenty years ago, has been marvelous. From the beginning of this period the JOURNAL spoke in no doubtful terms of the needs of the artillery service and the methods of satisfying them, and in the long period of its uninterrupted progress its influence has of necessity been a cogent factor in bringing about such results. In reviewing these facts a little natural pride may be pardoned in one who labored continuously through the first four years of the JOURNAL's life to make it a medium for bringing order out of chaos.

The JOURNAL, under the arrangements described, struggled on, growing in size and circulation, and with resulting changes the labor it demanded increased accordingly. In the fall of 1894 the editor was compelled to ask the Commandant for an assistant, and 2nd Lieutenant George Blakely, 2nd Artillery, was detailed in that capacity, and took up certain parts of the work.

V. OFFICIAL RECOGNITION AND CHANGE IN EDITORS

The military duties of the editor as police and ordnance officer, which had previously occupied the entire time and attention of one man, had increased to such an extent in 1895, owing to the growth of the post and the advent of modern guns and carriages, that it was no longer possible for one man to perform these duties and remain responsible for the JOURNAL. The long strain of several hours' work daily, running late into the night, for four years, in addition to his official duties, rendered it imperative that he should be relieved from the JOURNAL in order to save his health and eyesight.

The committee, therefore, wrote a letter addressed to The Adjutant General, United States Army, and forwarded it through the Commandant of the School, requesting the detail of 1st Lieutenant John P. Wisser, 1st Artillery, as editor. In this letter the question of official recognition of the JOURNAL was squarely stated, and had to be fairly met. Lieutenant Wisser was ordered to report to the Commandant of the School for duty. By this order the importance of the JOURNAL was appreciated, and the question of official recognition settled; and later years have shown the wisdom of this action. Thus the first critical point was safely passed; a change of editors had been effected, and the first editor in the fall of 1895 severed his connection with the publication and its responsibilities, to which he had cheerfully given his time. The work had been arduous and at times discouraging, but the reverse of the picture sometimes came into view, for it had its moments of pleasure, compensation and triumph. To have come into intimate contact with so large a number of men, laboring unselfishly and with eye single for the advancement of the service, and to have worked with them, is something to remember and cherish always.

A possible change in commandants in the early days had caused anxiety, but Colonel Frank fortunately remained at the school till the spring of 1898, by which time the JOURNAL was so well established that little was to be feared from unfriendly action.

After the JOURNAL was well started it was proposed to establish at the school a bureau of artillery information, the purpose of which should be to disseminate technical information for the use of artillery officers. This could have been easily accomplished through the great number of exchanges and other publications which the magazine was bringing into the school library; but the project was never executed for want of the requisite men to do the work.

It was part of the original plan to found an artillery association, the idea being considered an essential part of the program; but for reasons beyond the scope of these remarks, it was never realized. The advantages of such an association may best be studied in the Navy, where their Institute, during an existence of nearly forty years, has added united effort and team-work to their struggles for improvement, where otherwise but scattering individual skirmishing would have obtained. The other arms in our own service furnish similar object lessons.

It was also urged that a school of gunnery be organized at the school, but like the above mentioned schemes, this was never executed. So with respect to the last two considerations the Coast Artillery is now behind the other arms.

Individual effort and *esprit de corps* in the Coast Artillery are good, but the resultant of many forces working in combination for a definite end is lacking. The Corps has made great progress, but the idea must never get uppermost that nothing remains to be done, for many subjects are still untouched, and the problems unsolved, stupendous.

VI. Concluding Remarks

The foregoing covers briefly the main features of the early history of the Journal and the relation of existing questions to one another and the present. And now, if in this brief review one who, in striving to direct the course of artillery development, was on that account obliged to undergo many sacrifices and to assume grave responsibilities, and whose interest has never abated, may be permitted to say a few words more, these few words are:

1. Let not the personnel of the Coast Artillery Corps, which has done so well, ever become self-satisfied, for in that condition of mind progress ceases and efficiency dies. The Coast Artillery is no longer a small body of men with unimportant duties incompatible with the object of its being, but a large and efficient corps with well-defined functions and broad fields of opportunity. It has now before it great problems and obligations; small views of administration and instruction will no longer suffice—the methods thereof must be adjusted to big propositions. The Corps is now grappling with problems whose proper solution will affect the history of the world, and narrow-gauge policies will not fill the requirements.

2. Work steadfastly to supply the needs of the service. Maintain a broad and generous appreciation of the good work

of the other branches, and banish all narrow, petty jealousies that sometimes rise to mar good relations. Efficient officers cannot afford to be narrow.

3. Labor always for efficiency and take a loyal pride in high achievement. Work, singly and collectively, to promote team-work, which alone will secure great results.

4. Do not kill off all the "old" men too rapidly. Young men with energy and advanced ideas are invaluable in any organization, but the old men possess wisdom gained through experience which is indispensable to all successful undertakings. Officers of the latter class are better qualified than the former to discern shoals ahead and avoid them, and by their poise act as a balance-wheel to the pent-up energy of the younger men. These at least are the views of one who has knowledge of both classes, and has had experience in both capacities.

THE JOURNAL FROM SEPTEMBER, 1895, TO MARCH, 1902

By Colonel JOHN P. WISSER, Coast Artillery Corps

All honor is due the officers who boldly set to work to begin the Journal of the United States Artillery, with but little encouragement from any one. In the first place, it was necessary to interest the artillery officers and persuade them that such a periodical was a real need; then it became essential to obtain material for publication; finally, the Commandant of the Artillery School had to be convinced that the printing press of the school could be legitimately used for the purpose of printing the material furnished.

Fortunately, conditions at the school were favorable in *esprit*, the Commandant favored the scheme, and the officers who took up the matter were of the kind that accomplished, and, in spite of opposition in nearly all directions and but little encouragement in any, they succeeded in producing a very creditable periodical from the very beginning, so much so, indeed, that foreign and domestic periodicals of the highest standing at once agreed to exchange publications.

The most difficult part of the task had thus been accomplished, but, after two or three years of hard work on the part of those who initiated this great step toward the improvement of the artillery there came a period of depression; the artillery officers had not all responded with sufficient enthusiasm to encourage those who were giving their time (such as they could spare from their duties) to a labor of love, and the editor felt that some officer ought to take over the work who had no other duties to conflict.

In 1894, upon my being relieved from duty at the Military Academy, I was requested by Lieutenants John W. Ruckman and C. DeW. Willcox, who were both deeply interested in the Journal, to assume the editorship of it, but I declined because I had been away from my regiment a long time and wished to serve with it.

In 1895, however, Lieutenant Ruckman wrote me that he would have to give up the editorship because he had too much other work to do, and requested me again, in most flattering terms, to be his successor, and I finally accepted, and assumed my duties in the fall of that year.

My first efforts were directed towards increasing the number of subscribers and in this I was more successful than I anticipated. Then I tried to make the JOURNAL a little more popular, because a large number of artillery officers at that time were not interested in technical matters, and finally I wanted to interest the field artillery officers.

In the office I found as assistant Lieutenant George Blakely, who was of great assistance on account of his literary tastes and his capacity for work. We worked together in harmony for some time, indeed, until he was detailed as instructor at West Point. We promptly changed the JOURNAL from a quarterly to a bi-monthly, and tried to have at least one article of general interest, besides making a number of minor changes.

Although my duties at first were confined to the editorship of the JOURNAL I gradually acquired nearly all the special duties of the post, namely, ordnance officer (at a time when part of the armament was being mounted), engineer officer (when storage batteries and dynamos were being turned over to the artillery), signal officer, treasurer of the school, librarian of the school library as well as of the post library, instructor in the departments of engineering and the art of war, instructor of the school for electrician sergeants (which I organized and opened), and finally in command of my company. At one time I held nearly all these offices at the same time. Under these circumstances it was very difficult to give the proper attention to my work as editor.

Nevertheless, during the period of the War with Spain, when, as signal officer (among my other duties) I had charge of putting in all the communications for range-finding and fire control, directing instruction in the Ardois signal light and other signaling, and managing the power plants and searchlights, not a single number of the JOURNAL failed to appear. Again, before the war was quite over I asked to join my company (then at Fort Slocum, N. Y.) in hopes of getting to the front, and was absent for six or seven months, during which I kept up the editorship of the JOURNAL uninterruptedly. Finally, my company being sent to Buffalo for the Pan American Exposition, remaining away from May, 1901, to February, 1902, the work was still kept up and the JOURNAL appeared as usual.

During this last period I was assisted at the home office by Lieutenant Andrew Hero, Jr., who deserves great credit for helping me to tide over that interval. He worked assiduously and most intelligently, giving up all his spare time to this great labor. Without him I could not have kept the JOURNAL going.

We were fortunate in securing articles of international as well as general interest, such as those of (now) Colonel Beverly W. Dunn, Ordnance Department, Professor M. W. Humphreys, University of Virginia, Professor Crehore, Dartmouth College, Lieutenant G. O. Squier, Professor M. Merriman, Lehigh University, Colonel Wm. Cary Sanger, General Henry L. Abbot, Corps of Engineers, and others in the first year or two of our editorship, and this helped to make the JOURNAL more popular at home as well as giving it a high standing abroad.

During the War with Spain it was, of course, practically impossible to obtain a sufficient number of articles, consequently, in one number of the Journal in 1898 three of the five original articles were written by me, and at any time when the material was not forthcoming from other hands we supplied the deficiency in that way.

Another innovation in the JOURNAL was the introduction of articles on field artillery to interest the officers of that branch, regulars and militia.

The Index to Current Military Literature was also of much use, especially to the students at the Artillery School and to the Military Information Division in Washington. Soon after my taking charge the exchanges of the JOURNAL became so numerous and valuable that we were better off in that respect than the Military Information Division itself.

It is interesting to note that as early as 1900 the JOURNAL took an interest in the dirigible balloon and its military use, and articles foreshadowing the coming importance of field howitzers appeared several years before the Russo-Japanese War. Moreover, the JOURNAL contained the earliest literature on the subject of seacoast artillery fire control and the proper use of searchlights, submarine mines, etc., in modern coast fortifications.

In 1901 the artillery began to develop the power of the new material, both coast and field, and the JOURNAL served a very good purpose in enabling the officers to discuss methods and material freely and fully. The increasing interest in this subject is well illustrated by the numerous technical artillery articles which appeared at that time and for several years thereafter.

My promotion to major took me, in the spring of 1902, to other duties and a different station.

Looking back over the seven years during which I had the management of the JOURNAL, difficult as the task was at times, there is no feeling now remaining with me but one of pleasure in the work and gratitude to the artillery officers for the interest and encouragement they accorded me.

The JOURNAL has undoubtedly in the past fulfilled the purposes which its founders proposed for it, it is doing the good work today, and it should have the interest and support of every artillery officer for its future success.

TWENTY YEARS PROGRESS IN POWDERS, PROJECTILES, FUZES AND PRIMERS

By Captain WILFORD J. HAWKINS, (Coast Artillery Corps)
Ordnance Department

POWDERS

In comparing our ordnance of twenty years ago with that of to-day, one is struck with the revolutionary character of the changes. In this country, at least, it would seem as though the year 1892 marked the beginning of a new order of development in war material. Prior to that date, for thirty years or more, the changes in such materials had been slight except for the development of brown prismatic powder and the partial development of built-up rifled cannon.

The transition period in Europe had its inception four or five years earlier. The initial impetus seems in all countries to have dated from the first experiments with smokeless powders or with the development of the small bore, high power small arm or both. The key to the new development was furnished by Schœnbein and Bœttger when they discovered nitrocellulose, or gun cotton, in 1846; and by A. Nobel in 1888, when he brought out a colloidal powder, Cordite.

The French appear to have been the first to introduce new high power propellants into their service, using a BN powder composed of nitrocellulose and barium nitrate or possibly of other ingredients, inasmuch as their early efforts were shrouded in a good deal of mystery and accompanied by several changes due to unexpected difficulties experienced with their early powders of this type. These powders were first used in the Lebel small arm and were not by any means smokeless or otherwise ideal. Concurrently, Von Lenk was endeavoring to use gun cotton alone as a propellant by braiding it into cords or ropes and winding these tightly on a wooden core. Some success attended these efforts and Germany did some serious work in developing the idea, but it was inevitable that such a scheme should fail due to the not infrequent occurrence of erratic burning of an explosive in such a finely divided form. Many other devices were resorted to, all having the common object of slowing gun cotton in order to make it suitable for a propellant. The theory of granulation was well known and had long been applied in connection with black powders; the sphero-hexagonal grains of black powder, the varying sized irregular grains and the perforated cocoa, or brown prismatic, powder all bear witness to this. General Rodman, as is well known, was the leader of thought in this line by many years. To him, no doubt, we owe the early development of the multi-perforated smokeless powder grain, as he proposed such a granulation for charcoal powders, and this idea was resurrected coincident with the early development of smokeless powder in this country.

To go back a step to the efforts to force gun cotton to burn progressively, it is interesting to note some of the other expedients tried before a colloidal powder was finally evolved. In England, efforts were made to press up gun cotton into hard pellets with a matrix of india rubber. The use of small compressed cubes surrounded with paraffin was also tested. Simultaneously, the Italians were struggling along the same line with their Fossano powder, in which gun cotton was distributed through a less explosive substance used as a matrix. Schultz's pyroxylin sporting powder was the most successful of any powders of the non-colloidal type and is in use to this day. He made up a vegetable cellulose by the treatment of finely divided wood, which was subsequently nitrated, giving a vegetable nitrocellulose. To this he added potassium nitrate, barium nitrate, vegetable gelatin, and water. Although not a nitrocellulose powder, Brugere's powder is worthy of note among the early efforts to produce a stronger propellant than charcoal powder. His powder consisted of a mixture of ammonium picrate and potassium nitrate. It gave good results but was not smokeless or as satisfactory in other respects as the later colloidal powders.

In 1888, A. Nobel pointed the way to the practical solution of the problem by making a colloidal powder, cordite. This powder was composed of nitroglycerine, gun cotton, and vaseline. Soon after, colloidal powders of nitrocellulose alone were produced, using acetone as the solvent because of the high nitration of the gun cotton used at that time.

Thus in our earliest experiments in 1892 with smokeless powders, we, in the United States, found ourselves handicapped in being about four years or more behind the times as regards smokeless powder, and even more laggard as to high explosive for shell fillers.

The smokeless powder problem was first attacked amid considerable difficulties. In the first place, scientific research along these lines had not been made in this country and no native was conversant with the subject. Furthermore, the great domestic powder plants had been built for the manufacture of charcoal powders, and their owners were not as enthusiastic in developing the new propellant as they might otherwise have been. Another difficulty lay in deciding between a nitroglycerine-nitrocellulose, a pure nitrocellulose powder, and a BN type powder. Nothing was definitely known of any of them at that time in this country. No tests had been developed to determine the degree of stability possessed by these powders. That they might be responsible for a high rate of bore erosion, was not known until a year later. Furthermore, the shape of the pressure curve was not known, and many of our own early built-up guns had been designed for chase pressures incident to black powder propellants.

At this point it may be of interest to consider the array of artillery then in use by our service. It consisted of the 15-inch smooth-bore gun, the 8-inch converted rifle, the 37 mm. Hotchkiss light field gun, the 1.65-inch Hotchkiss mountain gun, the 3.2-inch field gun, and the 8-inch, 10-inch and 12-inch built-up steel rifles then in the type testing stage. It included also the 12-inch cast iron, steel hooped, rifled mortar, and the 12-inch steel rifled mortar, both then without carriages other than the Model of 1890 type carriage undergoing test.

However, in the face of this transition state of all our seacoast guns and carriages, samples of smokeless powders were obtained abroad and tested in 1892. One sample was of German manufacture and the other of the French, or BN, type. These were tested in the then new 12-inch steel breechloading rifle with astonishing results, so far as the experience of this country was concerned. For the same muzzle velocity, the weight of German powder was to that of brown prismatic powder as one is to three. The corresponding ratio for the BN powder was as one is to two. Furthermore, the maximum chamber pressures with the smokeless powders were less than with the brown powder. The difference was so great that the new powders were suspected of being capable of detonative action and attempts were accordingly made to detonate them with mercuric fulminate but without success.

In this year also, the .30 caliber Krag rifle was adopted for our service, and that led to parallel efforts to obtain a smokeless powder for the small arms cartridge. In fact, the development of satisfactory powder for that arm was depended upon to point the way for the selection of a smokeless powder for cannon.

To this end samples of Wetteren, Troisdorf, Maxim and Houghton smokeless small arms powders were obtained and sent to Frankford Arsenal for test and examination. An ordnance officer of experience was specially detailed to Frankford Arsenal to conduct tests with smokeless powders and to develop the chemical laboratory work involved. The early tests of smokeless powders as to stability were, as compared with present practice, extremely abbreviated. They consisted largely in exposing the powders to varying degrees of heat, to moisture, and to storage conditions in the assembled cartridge. The potassium iodide test was known and applied,—150° F and 15 minutes being, respectively, the minimum temperatures and time required.

In the ensuing year (1893) a number of samples of smokeless small arms powder were received at Frankford Arsenal and tested; Peyton, Leonard, Dupont, Axtell and Alters powders being of domestic manufacture; and Wetteren, Troisdorf, BNF, Swiss, Rifleite, S. R., and S. V. powders representing those of foreign manufacture. The Peyton powder was the only one of domestic manufacture worthy of note, and the standard of excellence was the Wetteren, with the Troisdorf also very highly esteemed.

Of smokeless powders for cannon, BN, German, U. S. Navy smokeless, Cordite, Troisdorf and Leonard powders were received and tested. The French BN powder was then in considerable favor as it contained no nitroglycerine, an ingredient even then much distrusted in this country. Firings with these powders were made in 12-inch, 8-inch, 5-inch, 4.72-inch and 3.2-inch guns. Troisdorf, a nitrocellulose powder of German manufacture was also in considerable favor as it gave uniform ballistics and was free from nitroglycerine. Cordite was not in favor, though it was known to have been adopted by England.

The subject of erosion in the bores of cannon first arose in this country at this time, and added another uncertainty to the already perplexing problem of selecting a suitable smokeless powder. It was thought that if erosion could not be avoided, the guns might be relined, an opinion which has since found expression in our practice.

The situation in 1894 was but little changed. Congress was insistent that a powder of domestic manufacture be adopted and every effort was made to stimulate the efforts of our own powder makers to produce a satisfactory powder. To this end, an ordnance officer was specially detailed at the works of the du Pont Company and provided with suitable ordnance at the works for testing the samples. The samples were slow of production as they had to be made up in small lots by hand in absence of any specially adapted machinery. Another officer was detailed on the Pacific coast to the Peyton Powder Company, and a proving ground provided at Benicia Arsenal.

In this year, the first ballistic specifications for smokeless cannon powders were drawn up:

Gun	Muzzle Velocity	Maximum Chamber Pressure
5-inch siege . .	1830 f.s.	31360 lbs. per sq. inch.
7-inch siege . .	1085 f.s.	26880 lbs. per sq. inch.
8-inch steel rifle .	2000 f.s.	33600 lbs. per sq. inch.
10-inch steel rifle .	2025 f.s.	33600 lbs. per sq. inch.

Various granulations were used, cord, strip, cube, and multiperforated. In the multiperforated, 19 and 21 and 7 perforations were used.

In 1895 Peyton smokeless powder (nitro-glycerine) began to be regularly used in loading .30 caliber small arms cartridges, the service having been completely equipped with the new Krag rifles by May of that year.

In the two succeeding years experiments with cannon smokeless powders continued; and in 1897 the first smokeless powder was issued to our service for use in target practice with the 3.6-inch mortar. Contracts were also placed during this year with domestic firms for Peyton, Rottweil, W. A., and nitroglycerine powders for 12-inch mortar, 10-inch and 8-inch guns. These contracts were divided among the California Powder Co., the American Ordnance Co., the Laflin & Rand

Co., and the du Pont Co. Also Peyton smokeless powder was definitely adopted and used throughout the year in loading .30 caliber small arms cartridges for the Krag service magazine small arm. No further orders for charcoal powders were contemplated by the Chief of Ordnance.

As a sidelight on the status of artillery target practice in 1897, the following table of allowances published in a general order may be of interest.

Gun	Projectiles per Battery	Powder
3.2-inch Field Gun	18 shrapnel 7 shell	IK
3.6-inch Field Mor.	7 shrapnel 8 shell	Smokeless
8-inch M.L. Conv'd Rifle	10 chilled shot Butler or Eureka	Hexagonal
8-inch 10-inch 12-inch B.L. Steel Rifles	3 shots each: 2 at 1725 f.s., and 1 at 2025 f.s.	Brown Prismatic
12-inch B.L. Mortar	3 shots	Black Mortar
10-inch S.B.	10 shots	Mammoth
15-inch S.B.	8 shots	Sphero-Hexagonal

(All shots at stationary targets.)

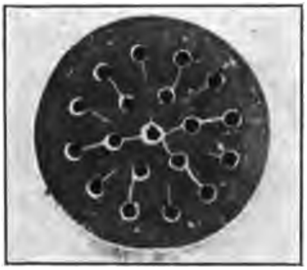
As germane to the subject of propellants, it may be stated that the Haskell multi-charge gun was tested at this time and found wanting; also that pneumatic guns were under test on the Pacific coast and that the Sims-Dudley dynamite guns were receiving consideration.

During 1898 and 1899 the situation as to smokeless powders continued about as before, the domestic manufacturers cited above being busy turning out their several types of smokeless powders in large quantities for the first time. A slight check to this work occurred in 1899 when all work of manufacturing smokeless powders was suspended on account of the destruction of an 8-inch and of a 10-inch rifle at Sandy Hook when smokeless powder manufactured in 1897 was being used. Upon investigation, however, confidence was again established in the smokeless powders under manufacture and the work resumed. The powder giving the destructive pressures was not of the type being manufactured and was found to have become brittle. This led to the present compression test of smokeless powders.

During the war of 1898, considerable newspaper agitation occurred on the subject of our defenseless condition as to a supply of smokeless powder; but this quieted down when it became known that all of our powder plants were doing their best to overcome the shortage.

The general trend of opinion was turning, during these years, towards the ultimate adoption of a pure nitrocellulose powder until, in 1900, that type was definitely decided upon for cannon. At this time, the rapid erosion of English guns under their cordite powder had become generally known, and that knowledge weighed heavily in making the above decision.

In 1900 sufficient confidence in our ability to make good common smokeless powder had been gained to warrant the placing of large additional orders with domestic manufacturers; but still the service had no smokeless powder except that for the 3.6-inch field mortar. In the ensuing year (1901), however, smokeless powder was also issued for the 3-inch 15-pounder D. S. Gun; and, incidentally, it is interesting to note that moving targets were first used in our target practice that year.



1170

END VIEW SMOKELESS POWDER GRAIN
INDICATING RESULTS OF BRITTLENESS

To increase our knowledge of smokeless powders and of other ordnance material, two ordnance officers were sent to Europe in 1901 to investigate those subjects. Their visit had valuable results in many lines of ordnance work. New stability tests for smokeless powder were soon after put in use, so that by the end of 1901 the following tests were used unstead of the K. I. test alone:

K. I. test;
Vieille 110° test (discarded later);

Wills' Explosion test (discarded later);
Troisdorf or German 135° test.

About this time also arose the suspicion that certain substances if present in the powder might mask the standard stability tests and thus render them useless. This matter was investigated and the use of certain ingredients forbidden.

It was in 1901 that we first demonstrated in this country the danger attendant upon the use of smokeless powder for saluting or blank charge purposes, the demonstration consisting in the entirely unexpected destruction of a 3-inch 15-pounder D. S. gun. It was later learned that similar experiences had occurred abroad.

The great length of time requisite for the drying of smokeless powder, especially of the larger granulations, having been brought forcibly to the attention of the Ordnance Department, various schemes to expedite the process were suggested. The expedient of drying in hot water for the removal of solvents and later drying in air, was tested and discarded as the stability and ballistics obtained under this process were unsatisfactory.

The study of smokeless powder continued during the succeeding year and resulted in the addition of the 115° Ordnance Department test; also in the discovery of certain basic laws relating to nitrocellulose and to the colloid made therefrom; as for instance:

(a) that after a certain point smokeless powder deteriorates more rapidly when hermetically sealed than when in the open air;

(b) that finished powder is not as stable as the nitrocellulose from which it is made; etc.

Consideration was also given to the subject of strip or tubular powders instead of the multiperforated grains in order to make the powder charge more wieldy and less apt to clog the breech box in inserting. A serious objection to long tubular powders for such fagoting was found to lie in the intense blow-pipe action of the combustion gases emitted from the bores of the tubular powder. Strip powders were unsatisfactory due to lack of progressivity.

By 1903, the manufacture of smokeless powder was fairly well understood and the manufacture of it progressed with greater confidence. That the resident inspectors (ordnance officers) were removed from station immediately at the works was due to this increased confidence, although the necessity for their relief was due to the scarcity of ordnance officers for other pressing work.

The cause of the development of critical pressures in the case of several powders of older manufacture was further investigated and, as a result, the powder specifications were changed so as to include a compression test and thus require a tough powder free from brittleness. The critical pressures occurred between 38,000 and 40,000 lbs. per square inch. The action at this point was such that for a very slight increase in the charge, a very great increase in the maximum chamber pressure would result. It was found that acetone as a colloiding agent was in some measure responsible for brittleness in the finished powder.

Although nitrocellulose powder had now been definitely decided upon for cannon, nitroglycerine powder was still used for the small arm propellant inasmuch as its keeping qualities seemed to be much better; and inasmuch as it did not give excessive erosion when used with the 220 grain blunt nosed bullet and the finally adopted muzzle velocity. This powder, therefore, continued to be used until the advent of the 150 grain sharp pointed bullet in 1906.

This year (1903) all artillery practice was, for the first time, had with smokeless powder.

In the following year (1904) the quality of brittleness was further investigated and many ballistic tests made in this connection. It was found that good nitrocellulose powder when heated continuously at 150° F to 180° F gave increased pressures and velocities up to a certain time, and that thereafter these qualities decreased. The reason for this phenomenon was not discovered, but it is, after all, a safe characteristic.

Some little discussion was also indulged in as to the danger of ether and air mixtures in service magazines. In certain proportions, the mixture was found to be explosive, but its presence was rendered unlikely by an improvement in the hermetic seal of the powder storage cases.

In 1905, the specifications for the manufacture of nitrocellulose cannon powder were further improved. The stability tests were increased in severity and greater care in the purification of the gun cotton was required. The hygroscopicity of nitrocellulose smokeless powders was also investigated. It was at first believed that increased moisture in smokeless powder resided only on its surface as a condensation, but this was later disproved. If this theory had been correct, the increase in moisture for various granulations must have been proportional to their surface areas; whereas, experiment showed that increases in moisture in all granulations, large and small, approached a common maximum lying between 2½ and 3%.

The Joint Army and Navy Powder Board was first convened in 1906 for the purpose of further improving smokeless powder specifications. This Board soon adopted the same specification for both Army and Navy powders and made some minor improvements in the specifications adopted.

The serious accidents which occurred in the Navy due to flarebacks brought up this subject for serious consideration in regard to the seacoast artillery. Tests were made, but it was soon demonstrated that for guns mounted in open air such phenomena would not occur. That combustible gases are present, however, was clearly shown by holding a lighted match at the mouth of a cartridge case extracted from a gun immediately after firing.

The adoption of the model of 1906 small arms cartridge with its light pointed bullet led to difficulties with erosion in the model of 1903 service rifle; and the greater part of the years 1906 and 1907 was spent in trying to meet this difficulty, more than 100 samples of powders being tested. The adoption of the present pyro, or nitrocellulose, powder finally resulted, thus terminating the history of nitroglycerine powders in our service. The new small arms pyro powder gave very excellent results so that the accuracy life was increased from less than 1000 to more than 10,000 shots.

The Joint Army and Navy Bowder Board continued its labors and the Army and Navy powder specifications were made identical. The influence of aldehyde in alcohol had always been much feared and the specifications had always prohibited its presence in the alcohol even in the minutest quantities. Upon investigation, however, it transpired that this substance, even if present in the alcohol to the extent of 5%, caused no decrease in the stability of the finished powder.

The great lengths of time required for the drying of smokeless powder, especially of the larger granulations, still engaged the attention of the authorities and quick drying powders were considered and tested, but with indecisive results.

During this year, the Coast Artillery service first received authority to reblend and weigh smokeless powder charges for service practice, and thus arose the interesting discussions between the "blenders" and the "anti-blenders." Whatever may have been the ballistic result of blending, it is certain that it was justified by the awakening of increased interest in the Coast Artillery.

The Joint Army and Navy Powder Board was active in 1909 in still further improving the smokeless powder specifications, especially as to the granulations best suited to the several service guns and mortars involved. Efforts were made to reduce the maximum pressures and thus to permit an increase in the muzzle velocity. The subject of bore fouling was also considered, with a view to reducing the amount and hardness of the deposit. In this year, the Army Powder Factory at Picatinny, New Jersey, was completed and the work of installing a small experimental plant for the manufacture of high explosives inaugurated.

In the three succeeding years up to 1912, the situation in this country as to smokeless powder has remained practically *in statu quo*, except for minor improvements. These have consisted in changes looking toward the further stabilization of the powder, the cheapening of the product, and the acceleration of the methods of manufacture, especially as regards the matter of drying. The Army Powder Factory at Picatinny has proved a most useful adjunct in the improvement and cheapening of smokeless powder, furnishing as it does a large laboratory, so to speak, in which the Army may try out under ideal conditions the various expedients suggested from time to time. To this factory is due credit for having developed a powder for the 12-inch mortar applicable to all zones, a boon for which the Coast Artillery has reason to be thankful. To it also is due credit for having demonstrated what the cost of smokeless powder really is.

In 1911 our smokeless powder was attacked in the foreign press on the ground that it could not be safely fired when heated as high as 150° F due to the multi-perforated type of grain and the composition. This gage was promptly taken up and firings made with the powder preheated to 208° F, with no excessive pressures not accounted for by the usual temperature compensation.

The small arms powder (pyro) has been further improved so that the accuracy life of the model of 1903 service rifle approximates 15,000 shots. The addition of a new ingredient has resulted in decreasing the bore fouling and increasing the accuracy. In the last annual competition held under the s of the National Board for the Promotion of Rifle

Practice for the selection of ammunition for the National Match, the government-made ammunition took second place, losing first place by a margin of a small fraction of an inch on the mean radii.

To sum up, it appears that we started in on the development of a suitable smokeless powder in 1892, four or five years behind our European competitors, and by 1903 had produced and issued a fairly satisfactory powder. From that date until 1912 the work has been in the nature of minor improvement until at this writing our powder seems to have reached a degree of perfection scarcely excelled by that of any other nation. This is particularly true of all our powders manufactured subsequent fo 1907. Striking evidence of this has been given by the destruction of the *Aquidaban* (cordite), the *Jena* (inferior nitrocellulose), the *Mikasa* (cordite), and the *Liberte* (inferior nitrocellulose). Two other explosions caused by the spontaneous decomposition of cordite have occurred, which happily were localized and did not destroy the ships, *i. e.* on the H. M. S. *Revenge* and on the H. M. S. *Fox*. Recent investigation of the French nitrocellulose powder indicates that inexcusable carelessness prevailed in that country in the manufacture, storage, and reworking of their powders. In Germany, it is understood that nitrocellulose is used in the army, except for howitzers, but that a nitroglycerine powder specially stabilized (other than by mineral jelly) is in use in the navy. Russia uses a nitrocellulose powder while Italy and Spain use nitroglycerine powders, ballistite.

We believe that nitrocellulose is superior to cordite or nitroglycerine powder for the following reasons:

a. Nitrocellulose of a lower nitration is used and this permits of better purification and gives a more stable cellulose.

b. Nitrocellulose is insensible to ordinary shock at all temperatures, whereas at moderately high temperatures cordite exudes nitroglycerine and becomes sensitive to shock.

c. With the stabilizers now in use, our nitrocellulose powder may be expected to withstand a storage of twenty years as against our experience of ten years or less for cordite.

d. The temperature of explosion of our nitrocellulose powder is about 50% less than the corresponding temperature for cordite. Consequently, gun erosion progresses much less rapidly with our nitrocellulose powder.

e. The chemical decomposition of our nitrocellulose powder in storage is at all times gradual and does not reach a critical stage beyond which the rate of decomposition is greatly accelerated and terminated by explosion. Cordite, on the other hand, is treacherous in this respect, giving good stability tests perhaps for a number of years and then suddenly decomposing in a few months to a dangerous condition, usually terminating in explosion.

England has evidently realized some of the disadvantages of cordite in recent years as is evidenced by the change from Mark I Cordite, containing 58% nitroglycerine, to Cordite M. D., containing but 30% of nitroglycerine.

If it were not for the fact that a change from nitroglycerine to nitrocellulose powder entails an immense pecuniary expenditure in guns, magazines, ammunition hoists and the like, it is not improbable that many countries now using nitroglycerine powder would change to a nitrocellulose of low nitration like our own.

PROJECTILES

Twenty years of progress in the manufacture of steel projectiles in this country covers very nearly the entire subject. The first attempts in the manufacture of forged steel shell in this country seem to have been made by the Midvale Steel Company in 1885 in connection with early experiments to determine the best material for 8-inch seacoast shell. These were used in connection with tests of high explosive shell fillers such as nitro-gelatin. The earliest orders for service steel projectiles of 8-inch, 10-inch and 12-inch calibers were placed in the early nineties and were small. They were mostly placed with the Midvale Steel Company, yet with that company in the first year under our consideration we find but one small order for 12-inch mortar shell.

In these early times, special alloy steels and the treatment of such steels was, in this country, an unopened subject.

Also at this time high explosive shell fillers in this country were primitive in the extreme. Various attempts had been made to use dynamite, nitroglycerine and nitrogelatin with but indifferent success, and with the not infrequent destruction of the guns used in the tests. The Winslow high explosive shell is perhaps the most ingenious device of this sort tested. In it the ingredients necessary for the production of nitroglycerine were enclosed in separate glass bottles, and there was provided a firing pin protruding to the rear through the base of the projectile so that it would be forced into the shell and ak the glass bottles upon the explosion of the propelling charge. It was supposed that nitroglycerine would be formed during the flight of the projectile. A time fuze of the old plug type was used. It was found that these projectiles seldom exploded and that when they did it was with a low order.

Various other high explosive projectiles were tested. Garrick's nitroglycerine shell appeared in 1885 as a forerunner of the Isham shell of later years. The Ordnance Department also tested a shell of this type but desisted after the destruction of a gun.

The controlling idea at that time seemed to be to convey the largest possible quantity of the highest possible explosive to the target in the lightest possible envelope. The benefits to be derived from confinement in a strong envelope to develop the full force of the explosive, or the possibility of obtaining penetration and a delayed detonation, seem not to have been considered. Neither was attention given to providing a sufficient quantity of metal in the envelope to provide an ample number of effective fragments delivered at the highest attainable velocity by virtue of strongly confining the detonation.

It is interesting to note that it was only shortly prior to 1892 that the Butler obturating sabot gave place to the copper rotating band placed above the base of the shell as we know it to-day.

In Europe the matter of shell fillers seems to have been better understood. In 1885 E. Turpin, an Englishman, patented the use of picric acid as a shell filler, Dr. Sprengel having shown in 1883 that this material could be detonated.

The salts of picric acid had also been proposed for use in powders as early as 1869 by Designolle, Brugere, and Abel. Designolle's powder, consisting of potassium picrate, potassium nitrate, and charcoal, was for some time used by the French as a shell filler.

In the same year (1869) Brugere and Abel simultaneously recommended a mixture of ammonium picrate and potassium nitrate. Later on, all of the picrates were investigated as to their suitability as shell fillers, ammonium picrate being tested abroad for this purpose prior to 1895 and found as satisfactory as picric acid.

The nitro-cresols were also tested abroad, the "Ecrasite" used by the Austrians being of this class and bearing the same chemical relation to cresol that picric acid bears to phenol.

In France prior to 1886 various mixtures of picric acid and oxygen carriers were used as shell fillers under the name of

"Melinite." But following Turpin's patent, picric acid alone was used under the old name. In England also cast picric acid was used under the name of "Lyddite," so named because the experiments with it had taken place near Lydd.

It was soon found that picric acid alone was unsatisfactory due to its tendency to form sensitive metallic picrates; so thereafter recourse was had to its chemically less active salts, such as potassium picrate and ammonium picrate.

Having described the general situation at the beginning of the period 1892-1912, we may trace the progress in that period.

One of the early orders for seacoast steel shell was placed with the Midvale Steel Company in 1892 and that company seems to have been remarkably successful in the manufacture of armor-piercing projectiles. In the following year, other orders for large caliber steel shell were given the same company under specifications requiring the use of the Holzer process.

In 1896, Emmensite was tested as a shell filler with fairly satisfactory results. This explosive was of the picric acid type with an addition of potassium or ammonium nitrate. Its stability was not considered satisfactory.

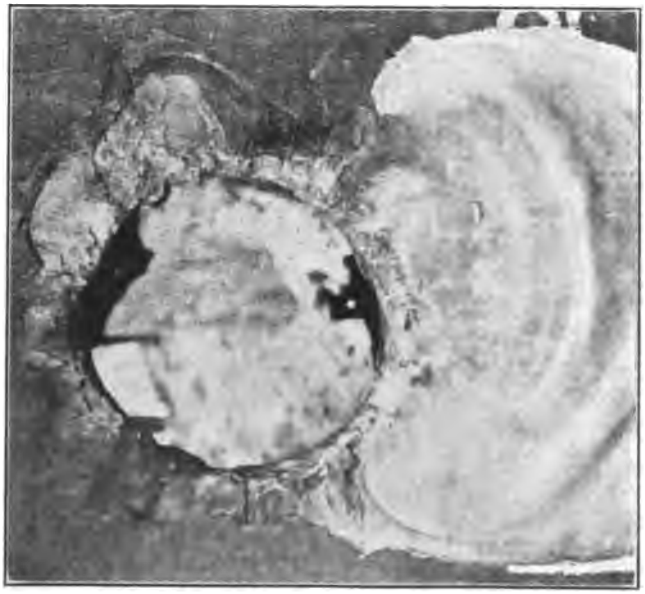
At this time and until 1897 the subject of high explosives was handled by the Board of Ordnance and Fortification under the well-known authority, General Abbot.

Experiments followed in 1899 with the Gathmann projectile, with the Isham projectile carrying nitroglycerine, with the Sims Dudley dynamite shell, with Joveite, and with Dr. Tuttle's Thorite.

The Gathmann wet gun cotton shell was a failure, as was also the Isham shell, as it provided only for an outside explosion. Thorite was rather favorably considered for a time, on account of its safety and insensitiveness; but it was nearly impossible to completely detonate it and it was decidedly hygroscopic. Joveite was a complex mechanical mixture containing nitrobenzol, picric acid, ammonium nitrate, sodium nitrate, and sodium oxalate. It was not favorably considered for obvious reasons. Thorite was not so complex, being a mixture of paraffin, a hydrocarbon, and ammonium nitrate.

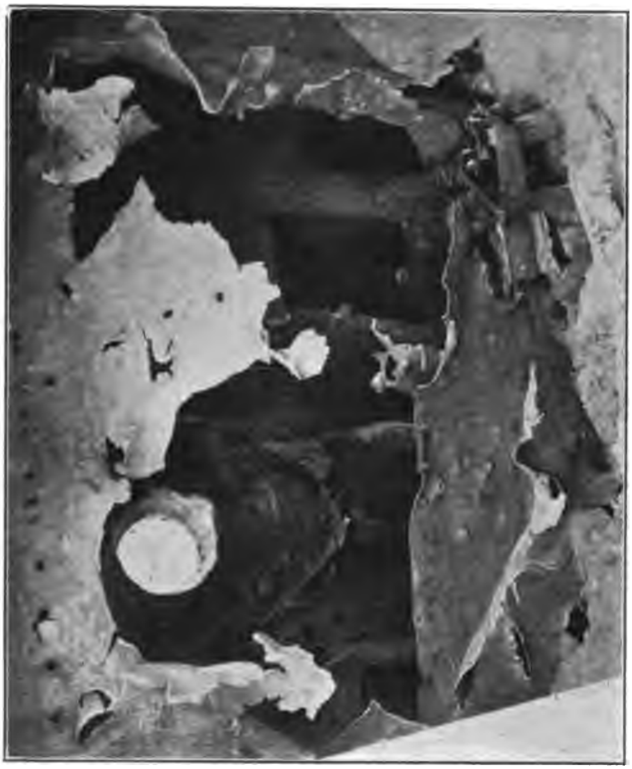
In the following three years (1900, 1901 and 1902) experiments continued with the Isham shell until it blew up a gun at the Proving Ground at Sandy Hook.

About this time explosive "D" made its appearance, as also Hudson Maxim's "Maximite." Explosive "D" was



1171

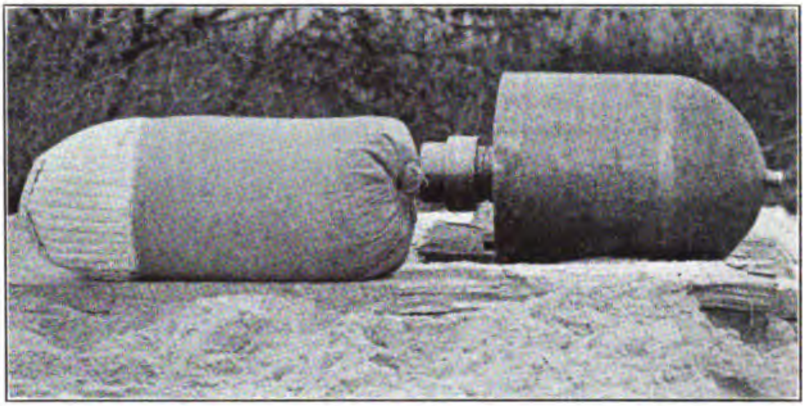
(In front)



1172

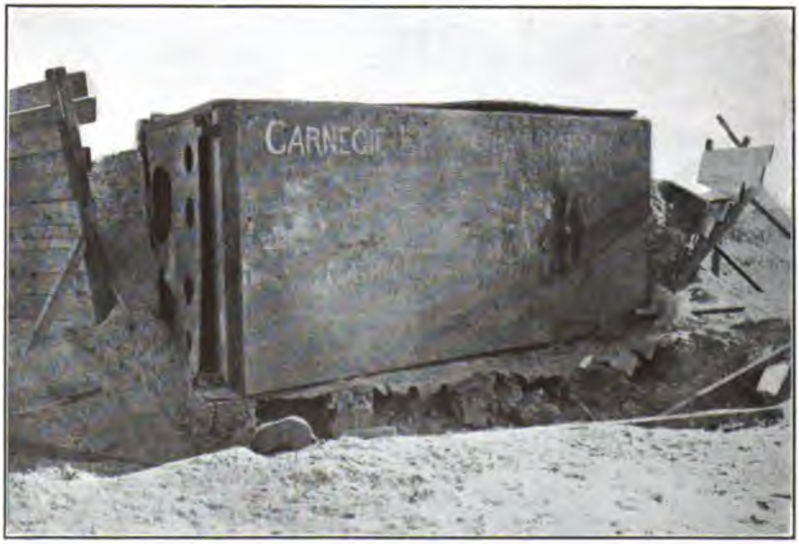
(In rear)

EFFECT OF SERVICE 12-INCH PROJECTILE



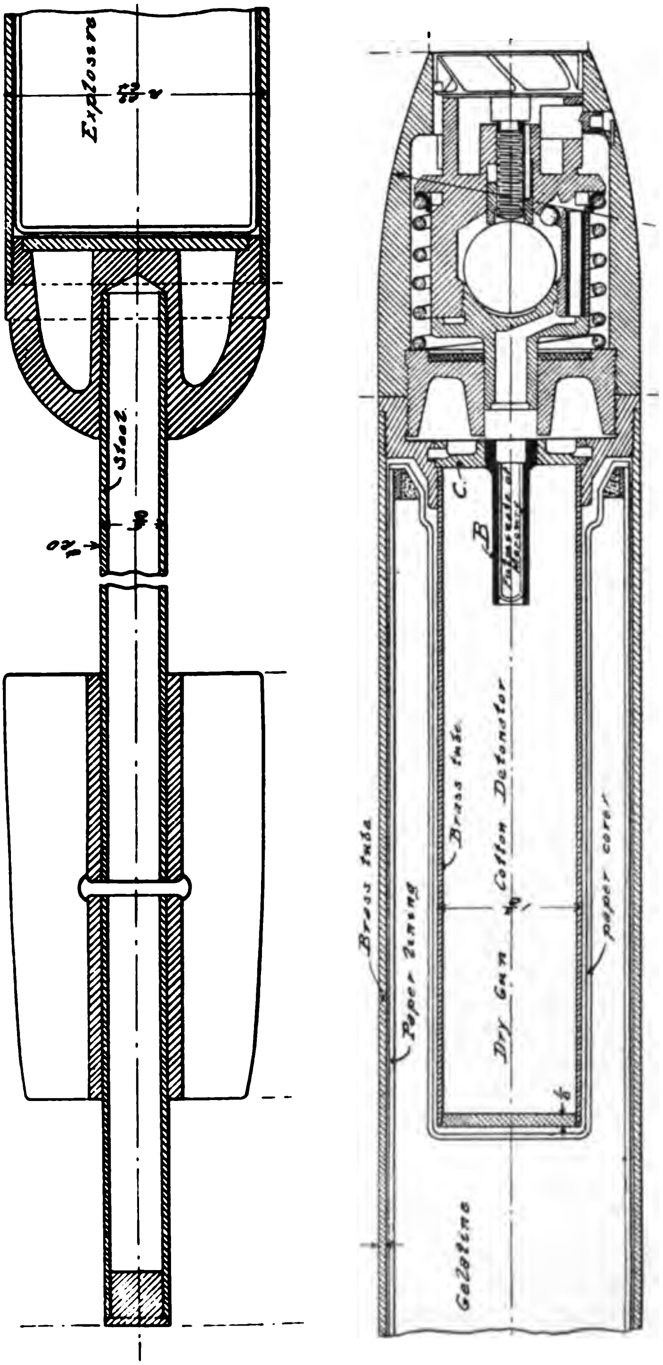
1173

Gathmann Gun-Cotton Shell, 1899



1174

Effect of Gathmann Gun-Cotton Shell, 1901



1175

SIMS-DUDLEY DYNAMITE SHELL, 1899

adopted for service, and "Maximite," picric acid, Rend Rock No. 400, and Thorite were favorably considered for service use.

Maximite was a mixture of mono-nitro-naphthalene and picric acid, which is apparently a recrudescence of Street's nitro-picro-naphthalene patented abroad in 1897. Later experience with Maximite showed that it was not sufficiently insensitive to uniformly withstand setback in the field gun, so it was discarded.

Thorite was used to some extent in field shell during the Spanish War and gave fair results.

Picric acid has also been used as a shell filler to some small extent, but its tendency to form sensitive metallic picrates has caused its discontinuance for that purpose.

As explosive "D" possessed nearly all of the properties of an ideal shell filler, it was definitely adopted as the standard high explosive for this purpose, and has given satisfaction.

In 1904 C. M. Wheaton proposed his shell filled with an anaesthetic.

It was also in 1904 that tests were made with armor-piercing projectiles with caps and without. The capped projectiles were found much superior as to penetration, and they bit as well on oblique impact as did uncapped shell. The cap was therefore adopted, and capped cast iron projectiles were issued for coast artillery target practice in 1906, the old projectiles having been redesigned, and a cap attached by means of a threaded tenon.

Following the adoption of the sharp pointed small arm bullet in the model of 1906 cartridge, experiments were made with sharp pointed cannon projectiles of similar form, and it was found that as much as 40% additional range resulted from the use of this form for the same muzzle velocity. Accordingly, a change to this form of projectile is in progress.

The standard projectile has also been further modified by the use of wide, continuous rotating bands. Bands up to one-third of the caliber in width were found to materially increase the accuracy life of cannon, offsetting the results of erosion, and have been adopted.

Tracers for night firing have likewise been added in late years but this device has not yet been fully developed.

Little has been said on the subject under discussion from the steel maker's point of view for the reason that the manufacturers give out no information as to their several methods. It is believed, however, that most armor piercing shell are made of alloy steel carrying nickel, chromium, or tungsten. This steel is, of course, heat-treated with a view to obtaining great physical strength combined with toughness. Roughly speaking, such heat-treatment usually consists in heating to a point above the absorption point of the steel and of quenching in oil. Subsequently the steel is heated again to a lower degree than before, the exact degree depending upon the compromise between physical strength and ductility decided upon by the steel maker.

During the past few years trinitrotoluol has come into prominence abroad as a shell filler. It has also been tested in this country with promising results. Its striking advantages are its cheapness, chemical stability, or inertia, and its certainty of detonation, combined with a high degree of insensitiveness to shock. It is very similar structurally to picric acid, or trinitrophenol, and to trinitrocresol. All three of these substances are more or less suitable for shell fillers.

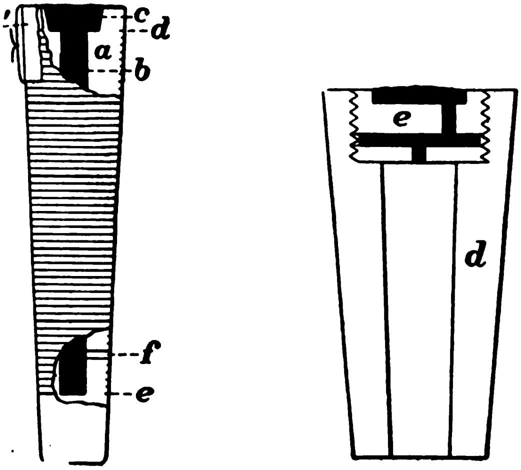
To sum up, our progress in twenty years of projectile manufacture has been to greatly increase the ability to penetrate, to develop a first class shell filler, to add wide continuous bands, to add armor piercing caps, and to sharpen the point so as to materially decrease the value of the coefficient of form.

FUZES

At the beginning of the period covered by this paper, our fuzes were very nearly in the same state as they had been during and since the Civil War. The time fuze consisted of a conical wooden plug holding compressed meal powder in an axial bore. The head of this column was provided with an igniting disc of meal powder treated with alcohol in order to increase the ease of ignition. Over all was pasted a paper disc upon which was written the rate of burning of the meal powder column. To use this fuze, the artilleryman consulted his range table, taking out the time of flight, and then computed the length he must saw off from the small end of the plug fuze to obtain the desired point of burst. The plug was then driven into the fuze seat and the shell pushed down the bore so as to leave the fuze pointing toward the muzzle. The fuze was lighted by the heated gases which passed around the projectile through the windage between the shell and the bore. The maximum time of flight obtainable with such fuzes was from 6 to 8 seconds.

The Bormann fuze was also used. Its ignition was accomplished in the manner first described but the meal powder time train was continued in an annular groove in a pewter fuze body in a manner similar to that now used in the dial type time fuzes. This train was covered with a pewter disc graduated in seconds, which was punched at any desired point for the admission of the igniting flame from the propelling charge. Upon ignition, the train burned in both directions until the reenforcing charge was ignited. The combustion of the igniting, or reenforcing, charge ignited the black powder shell filler.

The concussion fuze was also common. In this fuze, the time train stem was made so brittle that it would be broken by the concussion of the shell upon impact regardless of the part of the shell struck. The breaking of the time train admitted the flame to the shell filler at once.



1176 1177

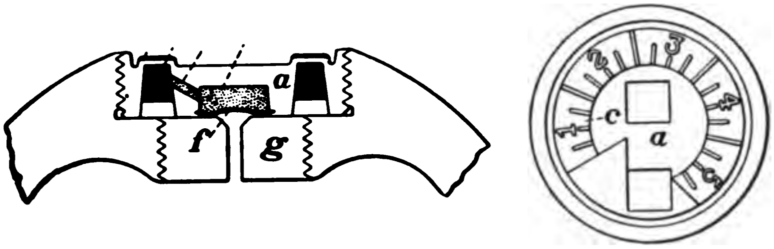
Plug Time Fuzes

For land use For seacoast use

The combination time percussion fuze (15 second and 28 second, model of 1891) had just appeared at the beginning of the period under consideration, but of detonating fuzes we had none. The simple base percussion fuze was also more or less a novelty at that time in this country.

The year 1892 found us engaged in making road tests with the 15 and 28 second combination fuzes to test the safety of the plungers in this respect. The use of an aluminum body, or stock, for these fuzes was also being considered in order to convert the weight so saved into shrapnel balls. Five inch and seven inch common shrapnel were at this time being designed for the then new siege material of these calibers. Experiments were also made during this year with the Merriam base percussion fuze. This fuze is particularly interesting as it embodied, at an early date, many features the importance of which was not apparently appreciated until several years later. The plunger restraining springs and the adjustable delay-nondelay device, are among the features referred to.

The earliest fuzes manufactured at the Frankford Arsenal had plungers of the Hotchkiss type, in which the barbed firing pin was enclosed in a lead filled plunger, the idea being that upon setback in the gun, the plunger would ride relatively backward over the barbed pin and expose the point of the firing pin in readiness for impact. This type of plunger was radically defective, inasmuch as this relative movement would occur gradually under the slight shocks incident to transportation, thus arming the plunger. This condition eventually led to a serious accident, after which the type was abandoned.



Bormann Time Fuze

The ring resistance type of plunger invented by W. J. Dungan, an employee at the Frankford Arsenal, was next adopted and has since been used in our service in great quantities. This device entered into the model of 1894 15 second and 28 second Frankford Arsenal combination fuzes.

At the time under consideration, there were two general types of time elements for fuzes: one, the dial type similar to that now used with our 3-inch field gun material, and the other, the spiral lead-inclosed time trains familiar to our service in the Frankford Arsenal 15 second and 28 second fuzes. The former was apparently the German type and the latter a French idea. As we had purchased considerable material from the Hotchkiss Company at that time, it is perhaps not unnatural that the spiral type should have been adopted. However, experience has proved it to be inferior to the dial type.

The development and issue of the time fuzes referred to, continued for several years; but it was not until about 1900 that serious efforts were made to develop a dial type fuze at Frankford Arsenal.

In 1899, the matter of fuzes seems to have been taken up in earnest and the "A," "17A20," "C," "M," and "W" fuzes were developed. At the same time the development of detonating fuzes received consideration.

The "A," "C," "M," and "W" fuzes are familiar to most of the artillery officers of our service as base percussion fuzes of different sizes appropriate for the various fuze seats and set-back conditions.

The detonating fuzes were difficult to develop, for the reason that violent explosives must be carried in them in sufficient quantity to excite insensitive shell fillers, while at the same time the fuzes must successfully withstand a high rate of impact retardation as well as bore acceleration. Fulminate of mercury was much distrusted, so the early development was along the lines of a nonfulminate fuze. The work of developing a satisfactory detonating fuze was continued through 1899 and 1900 until in 1901 the type had been established.

The succeeding two years 1902 and 1903 witnessed the early development of centrifugal plungers and their adoption. This period also covered the earlier work with delay action fuzes, and the first steps in the development of the model of 1906 dial type combination fuze.

In 1904, centrifugal plungers were further developed and certain old types of base percussion fuzes became obsolescent. This year also marks serious attempts to develop a practical side-impact fuze for use in certain mortar shell which at that time were unsteady in flight. The attempts, however, did not lead to the adoption of a new type of fuze, though the devices tested were most ingenious.

In the following year, the present standard types of detonating fuzes were approved for manufacture; *i.e.*, the minor, medium, and major caliber base detonating fuzes. The Hacherelle mechanical time fuze was also tested with poor results. Fuzes of this type have in the last few years been brought to a fair state of perfection by the great ordnance corporations of Europe.

The model of 1906 dial type combination fuze appeared the following year but was immediately succeeded by the model of 1907 combination fuze with hooded venting, the type since standard in our service.

During this year, 1906, the centrifugal plungers previously developed were abandoned, except for ordnance giving very low bore accelerations. The work of developing a 31 second dial type combination fuze was inaugurated to provide a fuze for the new 3.8-inch, 4.7-inch and 6-inch siege material.

The Semple centrifugal plunger was tested during 1907 and 1908, being adopted in 1909, after numerous and prolonged tests.

The years 1909 to 1911 have witnessed continuous efforts to develop a satisfactory high explosive shrapnel for the several calibers of mobile artillery material, together with fuzes suited to such projectiles. During this time, fuzes have been designed and tested for balloon gun projectiles and also for hand and rifle grenades.

Our progress in producing fuzes has not been so rapid as it has been in Europe, due partly to the fact that we are not equipped so well as our friends across the water. In one country there are five great ordnance manufacturing establishments, each maintaining a permanent corps of the best obtainable specialists for experimental and research work alone. However, in spite of handicaps, our time, percussion, and detonating fuzes do not compare unfavorably with those of similar foreign types.

PRIMERS

At the beginning of the period 1892-1912, we find but few primers in service, the radial vent friction primer and the similar axial and radial vent electric primer, together with the obturating friction screw primer for seacoast guns, representing the equipment.

In 1893 the friction primer for axial and radial vents received the safety wire coil connecting the body of the primer to the lanyard, so that the former would not be blown to the rear from an axial vent, as in the 3.2-inch field gun, and thus form a dangerous missile. In 1896 this safety wire was further improved.

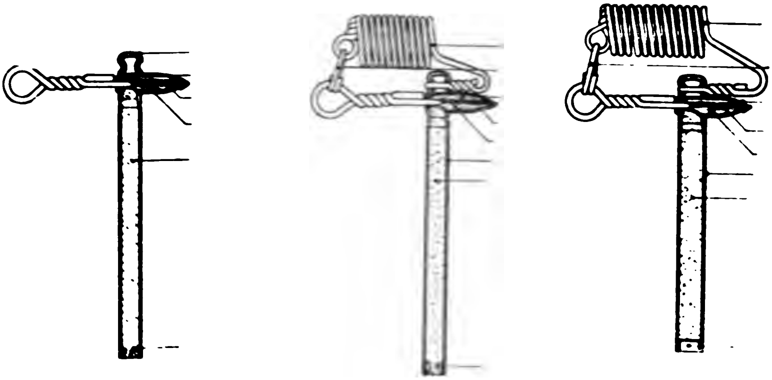
It was not until 1900 that the subject of primers was taken up seriously with a view to radically improving them. In this year, obturating electric primers, single wire, were developed, and electric primers for 5-inch and 6-inch rapid fire guns provided.

This year also marked the first development of obturating electric friction primers without screw threads on the primer body.

The whole subject of primers was investigated in the succeeding four years and in 1904 the following primers were adopted:

110-grain percussion.
20-grain percussion.
110-grain igniting.
20-grain igniting.
20-grain saluting igniting.

It was during this year that the Horney firing mechanism for seacoast guns appeared, and that the development of a threadless combination electric friction primer for use with it was undertaken.



1179

U. S. Friction Primers

Early models

In 1906 electric firing circuits were attached to the seacoast carriages; and by 1907 all of the primer seats in seacoast guns of 5-inch caliber and upwards had been modified to receive the combination electric friction primer.

During the years 1909, 1910 and 1911 further changes in the firing mechanism and primers have been considered and improvements of various kinds proposed and tested.

THE PRESENT-DAY TACTICS OF COAST ARTILLERY

By Colonel GARLAND N. WHISTLER, U. S. Army (Retired)

The best that can be said of the tactics of coast artillery at the present time, is that they are in a state of development. While the fundamental principles underlying the tactics of all arms of the service has been developed from long years of experience, the practical application of these principles has changed and always will change as the power of the weapon increases. During the past half century the power of the weapon used by every branch of the service, and the rapidity of fire, has increased so rapidly, that tactical methods have been continually changing to such an extent that text books upon the subject are hardly in print before the methods prescribed require revision.

In no other branch of the service have the improvements in guns and methods been so marked as in the coast artillery. Furthermore since the creation of the modern armament we have had practically no experience from which we can draw conclusive data. The coast artillery work of the Spaniards during the Spanish War and of the Russians furing the war with Japan are valueless. The only data that we have as to the effect of modern gun fire upon modern ships, is that obtained from the destruction of the Russian fleet by the Japanese navy, and it can hardly be maintained that the Russian fleet represented a modern naval force. It is also too much to expect that we shall gain any very valuable information concerning the best manner of conducting coast artillery defense from the existing war between Italy and Turkey.

In this connection it should also be remembered that no country has so extended a coast line, so many important harbors, so diversified conditions as the United States. In no country is the problem of coast defense so important as it is to us, and we must solve the problem for ourselves, based upon our own conditions.

The United States has the best coast artillery armament, the best system of fire control, the best system of submarine defense, and probably the best trained artillery personnel in the world, and to use a slang expression it is "up to us" to develop the best system of tactics for the coast artillery.

At the present time we have but a nucleus of a system of tactics, and in this paper my purpose has been to present a few fundamental principles which in my opinion should form the basis of a system of battle tactics. I have omitted all reference to submarine defense as this will be the subject of another paper in the series.

THE BATTLE TACTICS OF COAST ARTILLERY

It is not my purpose in this paper to enter into the details of the subject which properly belong in a text book upon battle tactics, but to discuss the general principles involved.

I use the term battle tactics in consequence of the fact that the tactics of coast artillery are confined entirely to fire action and do not involve any tactical maneuvers; the whole problem consists in determining how best to conduct and control the fire action of the battle.

While the fundamental principles upon which the tactics are based, are the same as those for other arms of the service, the practical application of those principles in the battle tactics of coast artillery differs materially in certain respects from their application to the mobile army.

The principal difference is due to the fact that the theater of operations, in fact the very battle field in which the action must occur, is well known and can be carefully studied during time of peace. A scheme of defense for every probable form of attack and, in some harbors, for every possible form of attack, can be prepared. Battle orders for every probable or possible form of attack can be formulated and systematized, in fact, practiced and experimented with at drill, so that each of such orders, probably indicated only by a number, shall convey to each subordinate commander exactly the form of attack which is expected and precisely what he is expected to do, and how he is to conduct or control the fire of his subdivision.

Furthermore, the position and power of our armament is fixed and cannot be altered; it cannot be reinforced during action, and if not situated in the most desirable position to meet a certain form of attack, it cannot be transferred to a ore advantageous one.

The fundamental basis of the battle tactics of coast artillery, is therefore, how to use a fixed armament of a given power, in a given theater of operations, to the best advantage, in endeavoring to repel any of the various forms of attack that may probably or possibly occur in such theater of action.

In the practical application to a given artillery district or battle command, it will be necessary to study carefully the theater of operations in order to determine: What character of attack may be expected or may be possible; the effective power of the various subdivisions; the field of fire of the several subdivisions; the ability to concentrate the fire of such subdivisions; the power and field of fire of such concentration; the probable amount of fire necessary to render the various classes of men-of-war *hors de combat*, and the concentration necessary in order to have a reasonable probability of accomplishing such purpose in the shortest time without undue waste of ammunition.

The only true measure of the effective power of a given gun, at a given range, against a given ship, is the damage that can be done by a hit, multiplied by the probability of hitting. The power of a battle command or of a fire command might be considered as inversely proportional to the number of rounds from such command necessary to put a standard battleship out of action, at some fixed standard range. Of course, it is impossible by any process of reasoning to make any such prediction, or to arrive at any conclusion which will be even approximately accurate. If, however, we start with an arbitrary premise that n hits from a 12-inch gun upon the deck of any battleship, will put the ship out of action, we can by a study of the probability of hitting as determined by target practice, and the relative powers of the guns of different caliber, determine the number of rounds to be fired from a given fire command, or battle command to give a *reasonable probability* of making a sufficient number of hits at any range to put a given ship out of action under the assumption of that premise.

The reason for establishing a system of this kind is to have a uniform method for determining the relative power of any battle command, fire command, or battery. The value to be assigned to n is purely arbitrary; it is, however, better that it should be taken at *too low* rather than at *too high* a value. The principle involved is that the fire action should be such as to give a 50% probability, that is an even chance, that a shell will at the longer ranges be exploded between decks at each round fired. By round is meant one shot from each gun fired at the target, whether fired simultaneously or in succession. If n is taken at too low a value, the tendency will be to concentrate too few guns upon the target to accomplish this purpose, in which case, should the result not be obtained, it is merely necessary to continue the fire. If, however, n is taken at too great a value, the result will be that too great a concentration will be made, resulting in a waste of ammunition at the longer ranges.

In my "Battle Tactics for Coast Artillery" I started with the *unquestionable fact* that the *least possible number of shots* that could put a ship of any kind out of action, was the explosion of *one shell between the decks*, whether the projectile entered through the side armor or through the deck. That is, a single shell exploding between the decks might put a ship out of action, but a number of shells might strike the ship without rendering it *hors de combat* unless a shell exploded between decks; not that a single shell exploding between decks necessarily would put a ship out of action, but that nothing less than that could.

My next proposition was that, in case of a vessel having, say, but one-third of the surface exposed to fire vulnerable to a shot, in order to secure a reasonable probability of exploding a shell between decks, there must be a reasonable probability of making at least three hits. Therefore, for what I called 1st Class Targets I made $n = 3$, for 2nd Class Targets $n = 2$, and for 3rd Class Targets $n = 1$.

That my system has been misunderstood, is shown by the fact that I have been asked again and again by officers of the Corps upon what I based my theory, that three hits would put a battleship out of action. Of course, I have never made any such assumption; my mathematical system is based upon the fact that three hits upon a 1st Class Target are necessary in order to have an even chance of getting one shell to explode between decks, which is the minimum number that could possibly put a battleship out of action.

PROBABILITY OF HITTING

It is now recognized by practically all artillery officers, that the battle tactics for coast artillery should be based upon the probability of hitting. In computing the tables of probabilities given in my "Battle Tactics," I first computed the variation in range due to known variation in velocity of the same charge of powder, and studied certain data which I had in my possession. I then adopted a percentage of probability for each defense zone: for the 1st 10%, for the 2nd 33⅓%, and for the 3rd 50%. These figures, while they were fair approximations to the result of my computations, were *purely arbitrary assumptions.* They were adopted for mnemo-technic reasons. The fractions $\frac{1}{10}$, $\frac{1}{3}$, and $\frac{1}{2}$ are easily remembered, and a battle commander could, without the use of chart or table, easily remember that he must fire 10 shots in the 1st zone, 3 in the 2nd, and 2 in the 3rd in order to have a reasonable chance to get one hit.

During the last few years we have obtained no data from target practice for ranges from 8,000 to 12,000 yards. I am of the opinion, however, that if a fire command were to open fire at 12,000 yards without trial shots at that range, and even if it should continue until the target were within 8,000 yards, the number of hits would not exceed 10% of those fired. Especially would this be true if several of the batteries were manned by coast artillery reserves.

Of course, our regular companies could do better than 33⅓% in the 2nd zone; but could we expect better from a mixed command of regulars and reserves? Within the 3rd zone our regular companies would probably make to-day 100% of hits, but I doubt whether we could expect more than 60% with a mixed command. It should also be remembered in this connection that our present data has been obtained from firing at a target the range of which changes very slightly during the firing of a series.

I am therefore of the opinion that *for battle purposes only* we had better adhere to the three simple fractions $\frac{1}{10}$, $\frac{1}{3}$, and $\frac{1}{2}$.

It is, in my opinion, of great importance that the *probable error* of guns at all ranges should be carefully determined, and I believe that we could well afford to forgo a year's practice, in order to obtain the ammunition to determine this data. Having determined the probable error, the probability of hitting a given target can be easily computed. This data would not only be of great value in determining the destructive power of our guns at the various ranges, but would also give battery commanders a means of comparing their firing with the best that could be expected from the gun. Almost every year we hear of battery commanders' receiving great credit for *lucky scores,* which tends to dishearten other officers, not so lucky, who have done splendid shooting, well within the probable error of the guns.

My idea as to retaining the simple fractions is merely for battle purposes—for the use of battle, fire, and battery commanders during action. They have a certain value for mnemotechnic reasons, and are sufficiently accurate for all practical purposes.

THE RELATIVE POWER OF OUR GUNS

I am free to confess that the method of comparison laid down in my "Battle Tactics" was extremely faulty, but, at the same time, after five or six years study I have nothing much better to offer. The problem is very difficult. Let us assume for the sake of argument that a 12-inch shell exploding between decks would *certainly* put a ship out of action (which is of course extremely doubtful); then a 14-inch shell would also certainly do so; consequently,so far as putting the ship out of action, the two guns are of equal power, although, of course, the damage done by the 14-inch shell would be greater than that done by the 12-inch.

Would a 10-inch shell exploding in the same place put the ship out of action? Would two 10-inch shells exploding between decks put the ship out of action? Probably not, unless they struck practically together in the same place as the 12-inch shell which is assumed to have put it out of action. It is, of course, reasonable to assume that two 10-inch shells would do more damage than one 12-inch shell, assuming that they carried a larger amount of explosive; but unless they exploded practically in the same locality they could not be expected to be as effective in putting the ship out of action.

It is manifest, therefore, that in comparing the relative values of the different guns, we must base our computation upon the probable *relative damages* that they would inflict.

The *perforating power* of a gun is given in the tables. To determine the *relative* perforating power of any gun at a given range, divide its perforating power at that range by the perforating power of the standard 12-inch gun at the same range.

The *battering power* of a gun at any range is proportional to its *remaining velocity multiplied by the weight of the projectile.* The *relative power* is obtained by dividing by the battering power of the standard 12-inch at the same range.

For convenience of battle tactics it is probably sufficient to compute the relative perforating and battering power for a mean range in each defense zone.

The *explosive effect* of a shell is directly proportional to the explosive charge, and the relative explosive effect may be determined by dividing the amount of the explosive charge by the amount of the explosive charge in the standard 12-inch. In order to obtain uniformity throughout the service the Chief of Coast Artillery might prescribe which type of 12-inch gun is to be taken as the *standard.*

In considering the *perforating power* of a battery, it will be necessary to take into account the position of the battery with reference to the channel, the angle of probable approach, and the area in which perforation is possible. Beyond that area the perforating power of the battery is nil.

The limit in azimuth of the *battering power* will not differ from the limit in azimuth of the *perforating power;* but the limit in range will be much greater, as the battering effect against a turret may jam it to such an extent as to practically put the guns therein out of action.

The explosive effect of a battery is nil, unless it is possible to get a shell between the decks, except in so far as an external explosion will amplify the battering effect. In an attempt to get a shell through the side armor the limiting area of explosive effect is the same as that of perforating effect.

In an attempt to get through the deck, there are two limiting ranges: the minimum within which it is not practicable to hit the deck, and the maximum where the range is so great that a shot would not perforate the deck. The latter limit only applies to batteries armed with guns of medium caliber, or to the secondary armament.

All of these things must be taken into consideration in determining the *relative power* and *effective area* of each battery.

This, however, merely determines the power of the battery in terms of the standard 12-inch gun, should they succeed in hitting. This value must be multiplied by the probability of hitting as determined preferably by the results of *actual target practice.*

GENERAL COMMANDS

I first advocated the system of general commands, such as "General System of Defense," which have been modified to "1st General Defense Plan," "2nd General Defense Plan," etc. These commands have been found cumbersome, and not easily sent through the telephone. I would, therefore, suggest that the several plans of defense be published in battle orders, and designated, "Battle Order No. 1;" "Battle Order No. 2;" etc. That system was adopted in the District of Puget Sound, the numbers being used also to indicate, or to convey, certain information. "Battle Order No. 1" was the system of defense for a fleet entering in a *single column;* "Battle Order No. 2," for a fleet entering in *double column;* "Battle Order No. 3," for a fleet entering in *three columns";* "Battle Order No. 4," for a bombardment; and so on. The number of the battle order conveyed instantly not only the proper plan of defense, but also the expected character of the attack.

Battle Charts

I would suggest the use of the following battle charts:

Battle Commander's Chart.—A chart containing in addition to what is now generally found on such charts, the value of the battle command in terms of the standard 12-inch gun.

Battle Commander's Auxiliary Charts.—A chart of each fire command giving its relative power in terms of the 12-inch gun, its areas of effective perforation, battering, and explosive effect, and without details as to individual batteries.

Fire Commander's Chart.—A chart giving the relative value of the fire command in terms of the standard 12-inch gun, with only general details as to each battery.

Fire Commander's Auxiliary Charts.—A chart of each battery.

Battery Commander's Chart.—A chart showing limit of explosive area, with projectile to be used, the same for perforating and battering areas.

All of these charts should be small and carried in a case from which they could be drawn when needed. If there are *n* battle orders there should be *n* fire and battery commanders' charts for each fire and battery commander, indicating thereon what must be done at each range. Each chart should have affixed a numbered tag. Should the command "Battle Order No. 3" be received, each commander would draw out by the numbered tag the chart pertaining to Battle Order No. 3, which tells him exactly what he is expected to do, without any necessity of relying upon his memory. The large charts usually posted up in the stations are useless.

General Fire Control

The general system of concentrating a large mass of fire at the extreme ranges on a single target with the hope of destroying it; dividing the targets between the fire commands in the middle distance; and assigning a target to each battery at the short ranges, for the reasons given in the "Battle Tactics for Coast Artillery," I still believe to be sound and the best that could be devised in formulating battle orders. The three fixed defense zones are, however, not practical in all harbors. In the District of Puget Sound a target might be in the 1st Defense Zone for three fire commands and in the 2nd for three others. Every harbor must be carefully studied, and battle orders formulated for the conditions as they exist. In many harbors it will not be possible to establish a simple plan which can be easily remembered; and it is for that reason that I recommend that for each battle order a set of battle charts be prepared for each subdivision affected by the battle order.

In conclusion, I would urge upon all officers to avoid the tendency to make our battle command drills mere perfunctory performances. An effort should be made to make every such drill a study of some problem connected with the defense of the battle area. I would recommend also that special attention be given to the mortar problem, for I become more and more convinced that the correct use of mortar fire is the crux of a true system of battle tactics for coast artillery.

I confidently expect to live to see the number of our mortar batteries doubled and trebled; the only fire ordinarily used at the extreme ranges, mortar fire; and gun fire withheld until the targets are within 8,000 yards.

COAST DEFENSE EXERCISES

AS HELD IN THE ARTILLERY DISTRICT OF CHESAPEAKE BAY DURING THE WAR CONDITION PERIOD, AUGUST 7-10, 1912

BY CAPTAIN HARRY C. BARNES, COAST ARTILLERY CORPS

The exercises consisted of a combined attack upon the fortifications of Fort Monroe from the sea and on land. This paper will be largely confined to the seaward side of the exercises, since the writer was in an excellent position to observe these operations, whereas his position was such that he was able to observe practically nothing connected with the land operations.

In the past we have been accustomed to having certain attacks represented during our coast defense exercises by boats available for the purpose, but the attacks have been delivered in such a manner as to present little or nothing realistic. At the conclusion of the exercises, all concerned have prepared more or less voluminous reports of their connection therewith and any action taken on these reports has usually been in the nature of an attempt to decide which side won. In the opinion of the writer, coast defense exercises, or any other army maneuvers, should never be planned with any idea of making decision as to who wins or who loses. They should be so arranged as to illustrate principles, and, if properly planned and executed, they will accomplish this result and impress their lessons more firmly in the minds of all concerned than would any amount of study or theoretical discussion.

Some days before the commencement of the exercises, committees were appointed by the artillery district commander to prepare plans of attack, rules to govern during the exercises, etc. Separate committees arranged for the seaward and landward operations. The writer was a member of the committee for seaward operations, the other members being Captain A. L. Rhoades, Coast Artillery Corps, and Captain R. P. Winslow, Coast Artillery Corps.

A "general situation" and "special situations," red and blue, were prepared, as a basis from which to start the exercises. Rules for the government of the umpires were also prepared and these, together with certain items of information necessary to a proper understanding of the operations on the part of the participants, were published to the command. A form was also prepared on which battery commanders should report all information regarding any firing done during each phase, such as targets fired upon, time target was assigned to the battery, time "Commence Firing" was given, number of rounds fired, kind of projectile used, mean corrected range, and position finding system used. These reports were submitted to the umpire as soon as practicable after each phase and were used for the purpose of keeping a record of the ammunition expenditure and of checking the battery commander's action in case any element of his battery was declared out of action.

The ideas embodied in these rules had been derived by the members of the committee largely from their work in connection with the Coast Defense Tactical Game, as developed under the direction of Major William Chamberlaine, Coast Artillery Corps, Director, Department of Artillery and Land Defense, Coast Artillery School, and the rules were intended to bring about conditions which would tend to illustrate principles. As to whether or not the events caused to occur during these exercises would or could happen in actual service in anything like the manner or at the times that they were caused to happen was not considered in any degree.

Certain tables were prepared for the use of the umpires in assessing damages afloat and ashore, which tables require some explanation as to the manner of their preparation.

The tables for determining the effect of the fire of the shore batteries are prepared from the following data:

Maximum rates of fire permitted

Mortars: Each pit, one salvo every two minutes.
Primary guns: One round each per minute.
Intermediate guns: Four rounds each per minute.
Secondary guns: Eight rounds each per minute.

Normal life of ships

Battleship or heavy armored cruiser: 1500 units.
Light armored cruiser or scout: 600 units.
Destroyer: 100 units.

In order to make the scoring of damage agree as closely as possible with actual tactical conditions, to find the life in units of any particular ship as represented the normal life of its class is multiplied by the speed of the ship represented and the product divided by the speed of the boat used to represent it; while the ammunition expenditure ashore is multiplied by the speed of the boat used and the product divided by the speed of the ship represented.

For example: The tug *Reno*, representing destroyers, is fired upon by a two-gun 6-inch battery for three (3) minutes.

Speed of destroyer = 30 knots.
Speed of *Reno* = 10 knots.
Normal life of a destroyer = 100 units.

Life of each destroyer $= 100 \times \frac{30}{10} = 300$ units.

Rate of fire of battery $= 2 \times 4 = 8$ rounds per minute.

Ammunition expenditure $= 3 \times 8 \times \frac{10}{30} = 8$ rounds in 3 minutes.

With these assumptions as to rates of fire and certain arbitrary assumptions as to the number of shots necessary to be fired in order to score a sufficient number of hits to put a destroyer or any other class of ship out of action (also arbitrarily assumed), Tables I, II, and III have been calculated. In making the calculations, however, all known data regarding the accuracy and power of guns were considered.

TABLE I.

UNITS SCORED PER GUN PER MINUTE FOR SHORE GUNS FIRING AGAINST BATTLESHIPS.

(*Life of a battleship = 1500 units.*)

Range	Mortars	Primary	Intermediate	Secondary
1000	—	100	80	32
2000	26	100	80	30
3000	25	88	77	26
4000	23	68	58	19
5000	21	52	45	13
6000	19	41	31	10
7000	17	31	26	7
8000	15	25	20	—
9000	13	20	16	—
10000	11	16	13	—
11000	10	13	—	—
12000	9	10	—	—

TABLE II.

UNITS SCORED PER GUN PER MINUTE FOR SHORE GUNS FIRING AGAINST CRUISERS.

(Life of a cruiser = 1200 units.)

Range	Mortars	Primary	Intermediate	Secondary
1000	—	100	100	50
2000	17	80	84	39
3000	17	60	67	27
4000	16	45	48	18
5000	14	33	35	12
6000	13	24	25	8
7000	11	18	19	6
8000	10	15	15	—
9000	9	12	12	—
10000	8	9	9	—
11000	7	7	—	—
12000	6	5	—	—

TABLE III.

UNITS SCORED PER GUN PER MINUTE FOR SHORE GUNS FIRING AGAINST DESTROYERS.

(Life of a destroyer = 300 units.)

Range	Mortars	Primary	Intermediate	Secondary
1000	—	100	133	100
2000	4	60	92	60
3000	4	33	50	30
4000	4	21	32	17
5000	3	14	20	8
6000	3	9	12	4
7000	3	7	9	2
8000	2	5	7	—
9000	2	4	5	—
10000	2	3	3	—
11000	2	2	—	—
12000	1	1	—	—

Before the exercises commenced, the ships to be represented and the speed at which they could maneuver were decided upon. It was thought most convenient to allow the following speeds for the different classes: Battleships, 10 knots; cruisers, 20 knots; destroyers, 30 knots. These assumptions determined the life of the various classes as shown at the head of the tables. Now, any of the tables may be used as follows: A destroyer (for instance) is fired upon at an average range of 4000 yards by a two-gun 6-inch battery. From Table III, one 6-inch gun delivers 32 units per minute. Two will, therefore, deliver 64 units per minute. Life of one destroyer = 300 units. Time necessary to put her out of action $= \frac{300}{64} =$ 4 minutes, 45 seconds, approximately.

From this, it will be seen that no claim whatever is made that any value attaches to these tables as a means of determining anything in regard to the number of shots or the number of hits from any caliber of gun or mortar necessary to sink a ship of any description or to injure her in any other way. The tables are, however, very useful as a means of bringing about results afloat which might reasonably be expected in action, and in a more realistic manner than has been done by any means heretofore witnessed by the writer.

The use of the tables will be illustrated by the following explanation: An action having started, targets are assigned and fire is opened by the various elements of the defense. For example, a fire command, consisting of two batteries of two 12-inch guns each, is directed by the battle commander to commence firing at a certain battleship division and opens fire on ship No. 1. An umpire in the fire commander's station, knowing the time when the first shot is fired from each battery and the range to the target, can, in a few seconds, find from the tables the time necessary for the fire command to continue firing in order to put ship No. 1 out of action; and when that time has elapsed he announces to the fire commander that this result has been accomplished. This information comes to the fire commander unexpectedly, as it undoubtedly would in action, and he must then change his batteries immediately to ship No. 2, or make any other assignment of targets permitted by the battle commander's assignment to him. The umpire also at once notifies the chief umpire that he has declared this ship out of action, in order that the ship's fire may be reduced accordingly, as will appear later. The fire commander also notifies his battery commanders and the battle commander at once of the umpire's decision. In case more than one fire command is assigned to the same target, an umpire in the battle commander's station takes the action outlined above for the umpire in the fire commander's station, he being notified in all cases by the subordinate umpires as to the time of the first shot from each battery of their fire commands. In this case, the umpire, when he declares the target out of action, notifies all subordinate umpires, as well as the chief umpire.

This expression, "out of action," is not intended to convey any definite idea as to the damage inflicted. It simply means that, for the time being, the ship has no fighting value, thereby making it proper to withdraw the fire of the batteries from her and direct it against a target which is uninjured and presumably more dangerous. The actual damage and resulting condition of the ship is determined by the chief umpire, after the conclusion of a phase, his decision being entirely arbitrary, but such as to indicate conditions which might, and probably would, obtain in action. Those concerned are then notified of the decisions in such terms as to convey the information to which each is entitled in the most realistic manner.

The tables for determining the effect of the ships' fire were prepared from the following data:

Maximum rates of fire permitted

Primary armament: One round per gun per minute.
Intermediate armament: Four rounds per gun per minute.
Secondary armament: Eight rounds per gun per minute.

The life, in units, of the shore defenses are determined as follows: Divide the fortifications into areas, not exceeding 300 yards square, number the areas from right to left along the water front and list the elements of the defense in each area. The number of units required to score a hit in any area is determined by dividing 2500 by the number of elements in the area. Each power plant, searchlight, fire-control station, gun, etc., in the area counts as an element. An example of such a table is given in Table IV.

As indicated in the fifth and sixth columns of Table IV, a given shore area being fired upon, a die is cast to determine the particular element of shore defense affected by the ships' fire. Where the elements in an area are less than seven, only a single throw of the die is required, as each count can represent a separate target, but, where the number exceeds six, it

is necessary to have some of the counts represent more than one element. The example shown in Table IV is a case in point, where the ace represents two elements (Light No. 6 and Light No. 7) and a second throw is required to decide which one of the two is struck. And when there is no six in the fifth column, as in the example given in Table IV, if a six appears on the first throw of the die, the die must be cast again until one of the counts indicated in the fifth column appears. Where the throw indicates that an element previously declared out of action is again struck, no action is taken other than that the chief umpire notes the fact, so as to consider whether or not this shot has occasioned further damage to that element. Where the number of elements in an area exceeds twelve, the number of units required to score a hit in the area is arbitrarily fixed at 200.

Table V, like Tables I, II, and III, was calculated using all known data regarding the accuracy and power of guns, the value of a unit being arbitrarily assumed.

To obtain the fire effect of any given ship proceed as follows: From Jane's "Fighting Ships", determine the number of guns of each class that she can fire ahead and on the broadside, and take the mean of these as the effective armament. To correct for the difference in speed between the boat used in the exercises and the ship represented, multiply the armament by the speed of the boat used and divide the result by the speed of the ship represented. The ammunition expenditure may be determined as described above for shore batteries.

For instance, the tug *Reno* represents ships of the *Canopus* class. The table of fire effect is prepared as follows:

Speed of *Canopus* = 18 knots.

Speed of *Reno* = 10 knots.

Armament of *Canopus:* Ahead: 2 12-inch, 4 6-inch, 2 3-inch. Broadside: 4 12-inch, 6 6-inch, 5 3-inch.

$$\text{Primary armament} = \frac{2+4}{2} \times \frac{10}{18} = 1.7.$$

$$\text{Intermediate armament} = \frac{4+6}{2} \times \frac{10}{18} = 2.8.$$

$$\text{Secondary armament} = \frac{2+5}{2} \times \frac{10}{18} = 1.9.$$

The table of fire effect for this ship is obtained by multiplying the units for each range, as given in Table V, by the number of guns in the effective armament and adding the results, as follows:

Range		Units
1000	$1.7 \times 100 + 2.8 \times 130 + 1.9 \times 80 =$	680
2000	$1.7 \times 85 + 2.8 \times 110 + 1.9 \times 70 =$	580
3000	$1.7 \times 60 + 2.8 \times 80 + 1.9 \times 50 =$	420

and so on, odd units in the large numbers being discarded and the nearest ten taken, for facility in handling the tables.

In this way, tables may be prepared for the areas presented by the fortifications of any harbor and for any ships that it may be desired to represent during the exercises.

The tables used during the exercises described in this paper were not prepared exactly in accordance with this description, but tables so prepared are thought to be an improvement over those actually used.

These tables, like the ones used in assessing damages afloat, have no value whatever as a means of determining the actual amount of fire which must be delivered by ships against any fort in order to put out any one or all the elements of the defense. Their use simply operates to make the exercises more realistic, and will be explained by the following illustration: The chief umpire is informed by the fleet commander, in advance of each phase, as to the time the attack will be delivered and what ships will be represented by each boat which he intends to use in that phase. For instance, the *Mills* might represent a division of four battleships, class B; the *Reno*, ten destroyers; the *Wetherill*, four cruisers, class A, etc. He also informs the chief umpire as to the areas to be attacked by each division. These messages are sent by radio at least four hours in advance of the contemplated attack in order to insure their receipt by the chief umpire before the attack commences, a simple code being arranged for use in this connection, in order that no information concerning the attack may get into the hands of the defense. The *Mills*, having opened fire, an observer in the chief umpire's station informs the chief umpire of that fact and gives him the approximate range, which he reads from a depression position finder. From the tables prepared as above described, the chief umpire finds that one battleship, class B, at the range stated (say, 6000 yards) will deliver, say, 90 units per minute. Four will, therefore, deliver 360 units per minute. Now, if the area being attacked has a value of 800 units, this division will score a hit in three minutes and have left over 180 units to apply on the next unit of time. Therefore, at the end of three minutes from the time the *Mills* division opened fire, it is assumed that a hit has been scored in the area attacked and the element affected is determined by the throw of a die, as shown in the explanation of Table IV, above. Whichever element of the defense is indicated by the die, that element is declared out of action and the proper persons immediately notified to that effect by telephone. This expression, "out of action," like that applied to ships, simply means that, for the time being, the element designated is not in operation—probably during the rest of the phase. The actual damage sustained and the resulting condition is arbitrarily determined at the conclusion of the phase by the chief umpire, and those concerned are then notified. In order that the operations above described may be properly performed and without confusion, it is necessary that an officer or an intelligent enlisted man be detailed to keep the score of each division of ships engaged. A form was prepared for this purpose, a copy of which is here shown.

Division.	Commence Firing	No. of Ships	Range	Units per Minute	Area	Units Required	Remarks
Mills	10:20	4 B/S B	6000	360	11	800	10:23 F'_1 280
							10:25 M'_1 200
	10:25		5000	600			10:26 B′ DeR —
	10:26	3 B/S B		450			10:28 SL6 100

The above record would indicate that the *Mills*, representing four battleships, class B, opened fire at 10:20 o'clock on area 11, approximate range 6000 yards; that at 10:23 a hit had been scored, with 280 units left over; that the die was thrown and F_1' declared out of action; that at 10:25 a second hit had been scored with 200 units left over and the die again thrown, M_1' being declared out. At 10:25 the observer at the depression position finder announced the range to the *Mills* as approximately 5000 yards, which changed the units delivered per minute by the division to 600. At 10:26 a third hit was scored with nothing left over, the die deciding that B′ DeRussy was out of action. At 10:26 the chief umpire was notified by the umpire in the battle commander's station that *Mills* division, ship No. 1, had been declared out of action, which reduced the units delivered per minute by the division to 450. At 10:28 a fourth hit had been scored with 100 units left over and searchlight No. 6 declared out of action, and so on.

In case more than one division were firing on the same area, one recorder, previously designated, should keep the total score by the following means: The units delivered each minute are called out by the scorer for each division and recorded by the designated recorder in the column of remarks, together with the units delivered by his own division. All are added together and the time when a hit is scored is then determined by this recorder. The operation is otherwise the same as above described in the case of a single division firing on an area.

All these tables might be entirely eliminated and damages arbitrarily assessed, but, undoubtedly, the leaving of events (that is, what happens and when) to chance, makes the manner and order of their occurrence much more realistic than could be done by any arbitrary action.

All coast artillerymen are now familiar with the term "emergency conditions," but I would venture to say that those officers who participated in these recent exercises have a much more concrete idea as to its meaning now than they had before the exercises, due to the fact that, at some time during one or more of the phases, each was informed, without warning, that some element of his command was out of action, whereupon he was immediately required to bring into use some emergency equipment.

For the period of these exercises, the artillery district commander, Col. F. S. Strong, Coast Artillery Corps, with his temporary staff, consisting of Captain H. C. Barnes, Coast Artillery Corps, and Captain Q. Gray, Coast Artillery Corps, and the chief umpire, Lieut.-Col. D. Skerrett, Coast Artillery Corps, took station in the tower on the ramparts near the postern gate. There was also a detachment of four enlisted men on duty in this station. The station was provided with a depression position finder, a telephone connected directly with the battle commander's station and one connected with the post system. This latter telephone gave the chief umpire connection with all batteries, fire and mine commander's stations and an additional telephone to the battle commander's station. An assistant umpire, Captain R. P. Winslow, Coast Artillery Corps, was stationed in the battle commander's station.

Upon receipt of information from the fleet commander as to the time a phase would commence and what ships would be represented by his boats, Captain Winslow was informed thereof. The observers on duty having discovered any boat participating in the exercises within range, the alarm was sounded and all batteries, stations, etc., manned. Upon proper identification of any of these boats, Captain Winslow would inform the battle commander as to the ships represented. For instance, the *Mills* being identified, he would inform the battle commander that she represented a division of four battleships, class B; the *Reno* being identified, he informed the battle commander that she represented a division of ten destroyers, etc., this information being that conveyed for each phase in the message from the fleet commander. The battle commander then gave his orders to his fire and mine commanders in accordance with his desires in the matter.

Due to a lack of sufficient officers, no umpires were placed in other stations and it was, therefore, necessary in each case for commanders subordinate to the battle commander to apply to Captain Winslow over the telephone for decisions as to damages to ships, stating the number of shots fired, caliber, and range. When a sufficient number of shots had been so reported, Captain Winslow would declare the ship receiving it out of action, and would notify the chief umpire thereof over the telephone. In the meantime, while this action was going on, as the ships were observed to open fire, the chief umpire, with the assistance of others in the artillery district commander's station, kept the score of the different divisions, determined the damage ashore and notified those concerned, as events occurred, over the post telephone. In this way, the action ashore and afloat and the resulting damages to both were kept constantly coordinated and the action was made exceedingly realistic.

The lack of a sufficient number of officers available as umpires, together with other complications, which can be smoothed out in future exercises like these, operated to delay the changing of targets, etc., and, therefore, caused fewer ships of the attacking fleet to be declared out of action than otherwise would have been the case, and consequently it appeared to the defense at times that they were not accomplishing the results that they were entitled to. This, however, when the purpose of the rules and their workings is thoroughly understood, should have no effect, since that purpose is served if elements of the defense are caused to go out of action in what would seem a realistic manner and cause appropriate emergency action to be taken, any damage afloat being assessed only for the purpose of bringing about conditions ashore which are desired (the necessity for changing targets, concentrating and dispersing fire, etc.), and to make the exercises as interesting as may be.

In these exercises firing was simulated as follows: The *Mills* and *Reno* were each equipped with one 6-pounder, which, when the ships represented were considered to be firing, were fired at minute intervals, the *Reno* firing single shots and the *Mills* firing three shots in rapid succession to assist the chief umpire in distinguishing their fire. Other boats used were equipped with Very pistols, which were fired at the same intervals during such periods as the ships represented were considered to be firing, each boat firing stars of a distinctive color. The shore batteries fired blank sub-caliber ammunition, one round per minute during such periods as they were considered to be firing. These methods were not altogether successful, since it was difficult to distinguish the fire from ships using Very pistols in day attacks, and the fleet commander could not at any time, either by day or night, see the flashes from the shore batteries. However, it should not be difficult to devise some satisfactory means for indicating fire and further efforts will be made to accomplish this result.

The following is a condensed diary of events as they occurred: The general and special situations and the rules governing the exercises were issued to the command on Saturday, August 3rd. The special situation, red, showed the ships composing the attacking fleet and indicated that the mission of the commander was to force an entrance to Hampton Roads and gain possession of the Norfolk Navy Yard and the Newport News Shipbuilding and Dry Dock Company. The special situation, blue, showed the information which the battle commander had as to the attacking fleet, its probable destination and mission, and the probable time of its arrival off the Virginia Capes, which was stated as the evening before the commencement of the war condition period; it showed also the conditions existing as to the coast guard and supports. The coast artillery troops, proper, assumed, were only those actually present.

The artillery district commander's station was designated as a bureau of information, to which should be sent any communications (letters or telegrams) to outside sources, such as the War Department, the Commandant, Fifth Naval District, etc., or any claims that might be raised, bearing on
nditions as they existed prior to and during the war con-
on period.

A record was kept of all ammunition, showing amounts of various kinds on hand, amounts allowed to be received and amounts expended in each phase. Where the records showed no ammunition on hand at any battery at any time, firing was not permitted from the battery concerned.

The war condition period was designated as the period from 12 o'clock, noon, August 7th, to 6 o'clock a.m., August 10th, 1912.

On the morning of August 7th, at 6:50 o'clock, the following message was sent to the battle commander, purporting to have been received by radio at 6 o'clock:

"Commanding Officer,
Artillery District of Cheaspeake Bay,
Fort Monroe, Va.

District Scouts on duty outside the Capes were driven in by hostile ships about 2 o'clock a.m., this date. They report the entrance within the capes of a large hostile fleet. The District Scouts and Harbor Entrance Patrol are maintaining touch with the enemy and I hope to be able to furnish definite information as to the composition of his fleet within a few hours.

A............... B................
Commandant Fifth Naval District."

Again, at 11 o'clock, a. m., on same date, the following message was sent to the battle commander:

"Commanding Officer,
Artillery District of Cheaspeake Bay,
Fort Monroe, Va.

District Scouts and Harbor Entrance Patrol driven in behind Fort Monroe shortly after daylight. Their reports indicate that the enemy has landed troops near Northend Point and that his fleet is composed of approximately five battleships *Vincent* and *Bellophon* classes, four *Kanopen* class, four *Royal Soverin* class, eight cruisers *Wey* and *Bristol* classes and twenty-five or thirty destroyers: also eight or ten Axilerys. The presence of submarines with the fleet is suspected but so far none have been definitely located. All communication with my Naval Patrol Stations in the vicinity of Capes Charles and Henry is broken.

A............... B...............
Commandant Fifth Naval District."

These messages contained information to which it was thought the battle commander was entitled, the names of ships and one or two words in the second message being intentionally misspelled for the purpose of simulating actual conditions. The information regarding a landing having been effected near Northend Point formed the basis of the landward attack, which, as before indicated, was carried on during this same period.

These messages indicate a line of procedure on the part of the chief umpire which could be followed, not only during the period of preparation, but throughout the war condition period as well, as a means of indicating action appropriate to conditions which might exist or arise during such a period in active service.

The first phase, which commenced about 3 o'clock, p.m., August 7th, consisted of a reconnaissance on the part of the red fleet for the purpose of determining the location and extent of the armament ashore. The boats engaged, with the ships represented and the areas attacked, were as follows:

Mills—4 battleships, class B, to attack Area 11.
Wetherill—4 battleships, class C, to attack Area 15.
Reno—4 cruisers, class A,,to attack Area 7.
Sater—10 destroyers, to attack Area 3.

The object of the reconnaissance was accomplished, since fire was opened on the various divisions of the fleet by all shore batteries in commission.

During this phase the following ships and elements of the defense were ruled out of action:

Afloat.—
  Mills division, ships Nos. 1 and 2.
  Wetherill division, ship No. 1.
  Sater division, ship No. 1.
Ashore.—
  M′$_1$; B.C. Lee; B′ Parrott; Gun No. 2, Dyer; B′ Montgomery; Gun No. 1, DeRussy; B. C. DeRussy; B′ Anderson; Gun No. 2, Lee; B′ and B″, Church.

The damages above stated were assessed at various times during the phase, as determined from the tables by the umpires those afloat causing corresponding reductions in the ships' fire by the chief umpire, and those ashore being communicated to the proper persons at the instant of occurrence. For example: M′$_1$ was declared out of action at 3:35 p.m., whereupon the mine commander was at once notified of the fact over the post telephone. Thereafter, no further operations were permitted to be carried on from that station. Likewise, B′ Parrott was declared out at 3:41 p.m. and thereafter Battery Parrott was required to forego the use of her horizontal base. Similarly for other damages assessed.

At the conclusion of the phase the chief umpire made rulings as to actual damages sustained and resulting conditions. Claim was made ashore that all stations should be considered to have been replaced by temporary installations, consisting of an azimuth instrument and the necessary telephones. The claim, however, was made in such general terms, no details beingstated (as for instance, whether or not the azimuth instruments and telephones were actually available in the district and just where they were to come from and how the repairs were to be made), that the claim was disallowed.

In this phase, Gun No. 1, DeRussy, was declared out of action. Ruling was made subsequent to the phase that the gunner had been killed and the sight and sight standard destroyed. Repairs were allowed and the gun was considered in action during the next phase.

Message was sent by radio to the fleet commander that *Mills* division, ship No. 1, *Wetherill* division, ship No. 1, and *Sater* division, ship No. 1, were all sunk and that *Mills* division, ship No. 2 was reduced in speed to 10 knots (this being due to injury to funnels). The battle commander was informed as to the sinking of these three ships (which, if it had actually happened, he would have seen) and that *Mills* division, ship No. 2, withdrew slowly, evidently unable to make better speed than approximately 10 knots.

In all cases, the information given was so worded as to indicate as nearly as possible the conditions as they would be known from what could be seen or from information derived from any other source properly available.

The following telegram was filed with the Bureau of Information at 5 o'clock, p.m., August 7th:

"The Adjutant General of the Army,
Washington, D. C.

Request shipment by railway express at earliest possible moment the following amunition rounds. Three inch eighteen hundred shell two hundred shrapnel. Six inch Six hundred eighty shell two hundred shot one hundred shrapnel. Ten inch two hundred seventy shell ninty shot. Twelve inch one hundred fifty shell seventy five shot. Projectiles armor piercing. Twelve inch powder one hundred thirty five eighteen ninety five ninety ninety ninteen hundred Mortars deck piercing shells eighty eigth twenty four four hundred eighty ten forty six. Torpedo shell two hundred forty. Fuses base covers cocking wire lead filling pieces for all. This ammunition is desired because enemy's fleet two battleship divisions one cruiser division ten destroyers are now within Chesapeake Bay. Enemy has already made reconnaissance of defenses Hampton Roads has been fired upon ships now withdrawn.

Haynes, Commanding."

As the war condition period was to be concluded on the 10th, it was manifestly impossible that the ammunition requested could reach Fort Monroe in that time, even were the request approved and the ammunition ordered shipped. Therefore, the following reply was sent to the battle commander:

"Commanding Officer,
Artillery District of Chesapeake Bay,
Fort Monroe, Va.

Reference your telegram this date in regard to ammunition Commanding Officers Moultrie Screven Barrancas and Morgan have been directed to ship such parts thereof as are on hand in their districts shipments to be made by express. Reports from Picatinny Arsenal that all your reserve ammunition should arrive at Fort Monroe by tomorrow at the latest. Advise by wire whether or not same has been received.

By Order of the Secretary of War.
McCain,
Adjutant General."

to which the artillery district commander replied as follows at 6 o'clock p.m., August 8th:

"Adjutant General of the Army,
Washington, D. C.

Reference your telegram yesterday, ammunition from Picatinny Arsenal has been received.

Haynes,
Commanding."

The second phase, which commenced shortly after 11 o'clock, p.m., August 7th, consisted of an attack on the searchlights, with a view to putting them out of action in order to make possible attacks on the mine fields. The boats engaged, with the ships represented and areas attacked, were as follows:

Mills—2 battleships, class B, and 2, class C, attacking Areas 1, 2, 8, and 11.

Wetherill—4 cruisers, class A, attacking Areas 14, 13, and 11.

Reno—10 destroyers, attacking Areas 1, 2, 8, and 11.

It should be stated, in this connection, that the designation of areas to be attacked (as, for example, 1, 2, 8, and 11) indicated that the ships would attack Area 1 until the searchlight in that area was occulted, whereupon their fire would be transferred to Area 2, and so on.

During this phase the following ships and elements of the defense were ruled out of action:

Afloat.—
  Mills division, ship No. 1.
  Wetherill division, ships Nos. 1 and 2.
Ashore.—
  Searchlights Nos. 4, 9 and 10; Guns Nos. 1, 2 and 3, and B. C., Irwin; M'$_2$; and Gun No. 4, Gatewood.

At the conclusion of the phase, actual damages and resulting conditions were decided by the chief umpire, as before, and those concerned notified. No definite action was taken as to resulting conditions at Batteries Gatewood and Irwin, as these batteries were not in commission and were not manned or used during the exercises.

The following messages were sent to the fleet and battle commanders:

Message to the fleet commander.—

> "Following damage in phase two. *Mills* division, ship No. 1, fire control damaged—can be repaired in twelve hours. *Wetherill* division, ship No. 1, out of action for the rest of the War Condition Period; ship No. 2, steering gear damaged—can be repaired in twenty hours. Searchlights Nos. 4, 9 and 10 were occulted at different times during the phase and were not put in action again. K——'s attack not allowed."

The following is an explanation of the remark concerning "K——'s attack." Lieut. K—— and five men were sent by fleet commander in the *Mills's* tender to make a landing at Fort Wool and destroy the searchlight located there, together with its power plant. Claim was made that Lieut. K—— succeeded in landing at the wharf without discovery and took ashore two logs of wood, representing dynamite; that he encountered one sentinel on the wharf and informed him that he was "out of action," that he, Lieut. K——, reached the light without encountering any other person and placed the charge in position. After taking this action, Lieut. K—— called the chief umpire's station on the telephone and reported what he had done. Upon being questioned, he stated that the *Mills's* tender represented seven destroyers and claimed to have landed twenty five men from each destroyer and to have taken Fort Wool. It was held by the chief umpire that, although the *Mills's* tender might have approached, as reported, without discovery, it was not probable that seven destroyers could have done so and, therefore, his attack was not feasible and was ruled out. Subsequently, it was reported by the fleet commander that Lieut. K——'s claim that his boat represented seven destroyers was unauthorized and that his attack, with five men, together with the accomplishment of his mission should be allowed. As a matter of fact, the disallowance of the claim had no effect, since the light which he claimed to have destroyed had already been declared out of action as the result of the fire from the *Wetherill* division.

Message to the battle commander.—

> "Following damages in phase two. *Mills* division, ship No. 1, ceased firing and withdrew from the action, evidently damaged to some extent. *Wetherill* division, ship No. 1, badly damaged—withdrew with great difficulty; ship No. 2, withdrew, evidently having difficulty with steering apparatus."

The following claims were presented after the second phase by the battle commader: "That the Artillery Engineer was sent to determine the damage to Lights 4, 9 and 10 and to make such repairs and replacements as might be necessary and practicable." The artillery engineer informed the chief umpire as to the material available for these repairs and replacements and it was ruled that they were practicable in the time available and, therefore, lights 4, 9 and 10 were allowed in action for the next night.

The third phase, which commenced about 9 o'clock, p.m., August 8th, consisted of an attack on the searchlights, similar to the second phase, combined with a small boat attack on the mine fields. The boats engaged, with the ships represented and the areas attacked, were as follows:

Mills—3 battleships, class B, attacking Areas 1, 2, 8 and 11.

McGregor—3 battleships, class C, attacking Areas 1, 2, 8 and 11.

Wetherill—3 cruisers, class A, attacking Areas 14, 13 and 11.

Reno—10 destroyers, attacking Areas 1, 2, 8 and 11.

Sater and *Mills's* tender, representing several small boats, attacking the mine fields.

The following ships and elements of the defense were declared out of action during this phase:

Afloat.—
- *Mills* division, ship No. 1.
- *Reno* division, ships Nos. 1, 2 and 3, from gun fire; ships Nos. 4, 5, 6 and 7 from mines.

Ashore.—
- Searchlights 4, 5, 6, 8, 9 and 10; Gun No. 1, Claiborn; Guns Nos. 1 and 2, Gates; B. C., Claiborn; Guns Nos. 1 and 2, Parrott; Gun No. 2, Gatewood; Gun No. 1, Hindman; B'', Montgomery; and B'', DeRussy.

At the conclusion of the phase the following rulings were made:

Mills division, ship No. 1 and *Reno* division, ships Nos. 1, 2, and 3, out of action for the rest of the war condition period.

The fleet commander was so notified and the battle commander was given the information in an appropriate manner. After further consideration, decision was made that the destroyer division had encountered the mine fields, the result of which was reported to the fleet and battle commanders in the following messages:

Message to the fleet commander.—

"Following additional damage in third phase. Four destroyers out of action due to encountering the mine fields. Total destroyers out to date, eight. As the result of this encounter, the chief umpire rules that the officer in command of your small boat attack (on the mine fields) reported to you this morning that a passage had been cleared and buoyed through two lines of mines, but that he suspected the presence of a third line."

Message to the battle commander.—

"During the third phase, the *Reno*, representing destroyers, encountered the mine fields. The destroyers were thrown into confusion and but two or three of them were seen to withdraw, still represented by the *Reno*. Daylight disclosed four destroyers, badly crippled and beached at various places. After the searchlights were declared out, attack was made by small boats on the mine fields. As the result of the above circumstances, it is ruled that three mines, consecutively numbered, of the outer and second lines of mines tested bad at daylight."

The intent of these messages was, first, to indicate to the fleet commander that he had not yet cleared a passage entirely through the mine fields and that, therefore, it would be necessary to make a further attack to accomplish this purpose, in order that he might logically attempt a run by; and, second, to indicate to the battle commander that his mine fields had been damaged. Claims were made and allowed as to certain repairs and replacements of searchlights, which left the defense with four lights in commission on the evening of August 9th.

The fourth phase, which commenced about 9 o'clock p. m., August 9th, was an attack similar in all respects to the third. The boats engaged, with the ships represented and the areas attacked, were as follows:

Mills—2 battleships, class B, and 3, class C, attacking Areas 1, 2, 8 and 11.

Wetherill—3 cruisers, class A, attacking Areas 14, 13 and 11.

Reno—10 destroyers, attacking Areas 1, 2, 8 and 11.

Sater and *Mill's* tender, attacking the mine fields, as before.

The following ships and elements of the defense were declared out of action during this phase:

Afloat.—
- *Mills* division, ships Nos. 1 and 2.
- *Wetherill* division, ship No. 1.
- *Reno* division, eight ships.
- All out of action during the rest of the war condition period.

Ashore.—
- Searchlights 4, 5, 6 and 8; B′, Eustis; Gun No. 2, Claiborn; B″, Ruggles and F'_1.

The fleet commander was informed subsequent to the phase that the destroyers had again encountered the mine fields; that two destroyers and his small boats returned to him; and that the reports of officers thereon indicated a clear passage through all lines of mines.

During this fourth phase, F'_1 was declared out of action and the fire commander so notified. Before the phase was over the fire commander reported to the chief umpire that he had taken possession of the meteorological station and had actually connected himself by telephone with his batteries and had communication with the battle commander over the post system. As this was the only real repair made of damage assessed during the war condition period, it was ruled that the personnel of the fire commander's station had been saved in some miraculous manner when the station was destroyed and that they might, therefore, consider themselves in action again.

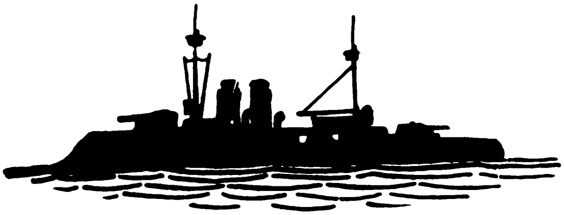
The fifth and last phase, which commenced about daylight on August 10th, consisted of an attempt to run by the fortifications. Due to a misunderstanding of orders, the artillery personnel were allowed to turn in after the fourth phase, leaving no one on duty except a telephone man in each station, the result being that the whole attacking fleet, less ships declared out in previous phases, had advanced to within very short ranges before the shore batteries were manned. Early in this phase, the battle commander's station, as well as F'_2 and F'_3, were declared out of action. This caused considerable further delay in opening fire from the shore batteries and was very instructive as an object lesson, showing what the conditions probably would be, should these stations actually go out in action, unless some measures were taken in advance to provide for such a contingency.

We have all, at one time or another, read or heard discussed what the probable forms of naval attack against coast forts are. We have heard of reconnaissances, bombardments, raids, attacks on the mine fields, etc., but the forms of attack presented during these exercises by Captain Rhoades, who acted as fleet commander, were most excellently thought out and were executed in a manner which left less to the imagination than any it has been the writer's good fortune to witness. Captain Rhoades's ideas on this subject were largely the result of his experience as fleet commander operating against Fort Monroe in the "Coast Defense Tactical Game" in the Coast Artillery School, the value of which game to the Coast Artillery Corps, as a means of instruction for officers, cannot, in the opinion of the writer, be overestimated.

The writer is indebted to Captain Rhoades for the entire preparation of the tables described in this paper for the use of umpires in assessing damages afloat and ashore, and wishes to express his appreciation of Captain Rhoades's efforts in this direction, as well as for cooperation by him and Captain R. P. Winslow, Coast Artillery Corps, in the work connected with the preparation of the rules governing the exercises.

It seems needless to go into any details as to how exercises similar to these can be planned and executed in other artillery districts, but it is suggested that it would appear very desirable that they should be arranged for during periods when as many troops from other districts are present as is possible. During these exercises, three companies were present from the Artillery District of the Delaware and assisted very materially in the land operations. It would also add to the exercises if the student officers in the Department of Artillery and Land Defense, Coast Artillery School, who have had experience in the operations of the Coast Defense Tactical Game, were made available as umpires.

It also seems quite feasible that ordinary battle command drills might be greatly improved and made much more interesting by the adoption of certain parts of the scheme on which these exercises were based.



COAST DEFENSE IN THE CIVIL WAR*

THE PORT ROYAL EXPEDITION

CAPTURE OF FORTS WALKER AND BEAUREGARD

By First Lieutenant JOHN L. HOLCOMBE and First Lieutenant WALTER J. BUTTGENBACH, Coast Artillery Corps

General Situation

It was considered necessary in blockading the Atlantic coast from Hatteras to Florida to occupy as many southern ports as possible—furthermore, by holding the blockade within a harbor, it could be maintained by fewer ships and with much less fatigue than when holding an exterior blockade.

Special Situation

By holding Port Royal, the Navy acquired a fine base, and made it possible to maintain an effective blockade within the entrances of the whole coast from Charleston to Cape Florida, except at Fernandina.

Opposing Forces

WORKS

Fort Walker was located on the upper end of Hilton Head Island, being on the left of the channel entering into Port Royal Sound. It was a closed earth-work having 21 guns mounted on the ramparts, of which 13 constituted the Channel Battery, their arrangement and classes being as follows:

In the center.—

1 10-inch columbiad, on the right flank
5 32-pounders, and
1 9-inch Dahlgren gun.

---

* See note to "Coast Defense in the Civil War, Fort Sumter, S. C., (First Attack)," in Journal U. S. Artillery, for March-April, 1912.

On the left flank six guns in the following order.—

1 32-pounder,
1 8-inch columbiad,
3 42-pounders, and
1 24-pounder, rifled.

In all, 13 guns on the sea front.

Besides, there were guns as follows:

North bastion	1 32-pounder,
South bastion	1 32-pounder, 1 8-inch howitzer, 1 long 12-pounder,
South flank of bastion	1 32-pounder (navy),
Demi-lune	2 24-pounders,
Redan	1 8-inch howitzer (navy).

In all, 8 guns on the land front.

The fort further had,

1 8-inch howitzer, not mounted,
2 carronades, buried in the sand,
1 12-pounder, mounted in front of the work, which made a total of 25 guns.

Of the eight guns on the land front, one on the north bastion and two on the south flank could occasionally be used against ships, but the others could not.

To man the guns within the fort, and to serve as an infantry reserve outside, there were, until reinforcements arrived on the afternoon of the 6th of November, the following:

Two companies Col. Wagener's 1st Artillery, S. C. Militia, being 152 men,

Three companies Heyward's South Carolina Vols., being 210 men,

Four companies Dunovant's South Carolina Vols., being 260 men, or

Total: 622 men.

There were besides, when reinforcements arrived, 65 cavalrymen and 450 infantrymen, and a 2-gun 12-pounder battery of field artillery, from Georgia. While there were near enough to serve as additional reinforcements, some 650 men of the 15th S. C. Vols., of whom, in fact, 220 were inside the works at Fort Walker.

The guns mentioned, owing to the limited space available, had to be put so close together that no traverses could be constructed to save the batteries from enfilade fire. The salient of the bastions of the fort on the land side, as also the demi-lune had been arranged for circular traverses, but were not so used.

In one case a long navy carriage was made use of, an embrasure being cut through the salient of the demi-lune, while a barbette carriage was placed in the salient of the south bastion; and on these carriages two 8-inch navy howitzers were mounted. An 8-inch howitzer which was on hand for the salient of the north bastion, was not mounted, no carriage being available. One 32-pounder (navy) was mounted in the exterior angle of each bastion, and one long English 12-pounder, in embrasure, was placed in the shoulders to enfilade the curtain face of the work. But one of these was afterwards removed for beach defense, as was also an 8-inch howitzer. Two 24-pounders in barbette were mounted in the demi-lune.

For beach defense were designated two heavy shell guns, which were to occupy the two exterior flanking works commanding the beach and the approaches on both sides. They were to give a cross fire on the front of the glacis, or to cover the water front of the works; but there were finally used only two carronades, without carriages, simply buried in the sand, and pointing in the designated direction, affording fire in case the works were stormed. Also the 12-pounder on the north bastion was put in in such manner as to sweep the beach along any approach from the south, while the ditches on the water front not protected by bastions had caponieres constructed of palmetto logs, pierced for two tiers of musketry and approached by galleries leading under the parapets from the interior of the fort. Thus, in case crossing the ditch were attempted by any one, he would come under a cross fire of ball and canister.

As a protection to the land batteries of the fort a heavy longitudinal traverse was built; and to insure against casualties from shot and shell bursting on the parade, small traverses in rear of each gun of the water battery were built, sufficiently low, however, to offer no obstacle to the passage of such shell as might graze the parapet of the water front.

It was further intended to construct a splinter proof over the entire space between the principal traverse and the curtain of the work, but material was not furnished in sufficient quantity. With the material obtained, only one-third of the intended space could be covered.

The magazine of the work was large and complete and so well protected that, although an enormous amount of shot and shell was fired against it, it sustained no damages.

Temporary hot-shot furnaces were erected.

Constructing a line of infantry works about two miles to the south, and erecting a battery where Skull Creek enters Broad River was contemplated, but neither was accomplished.

Fort Beauregard was situated on Bay Point, Philips Island, across the channel from Fort Walker, the distance between the forts being $2\frac{5}{8}$ miles.

Fort Beauregard was an earthwork of four faces, all fronting on the water, and the guns were so mounted on each face as to command the approaches to Broad and Beaufort rivers.

Its main work mounted

5 32-pounders,
1 6-inch rifle,
5 42-pounders,
1 8-inch columbiad,
1 10-inch columbiad, or in all
—
13 guns.

There were inside the fort also 2 6-pounder field pieces (old Spanish guns). About 150 yards on either flank were two small outworks, connected with the main work by trenches, in one of which were mounted two 24-pounders (sand battery), and in the other three 32-pounders (hot-shot battery).

The garrison consisted of 3 companies of the 9th S. C. Vols., 6 companies of the 12th S. C. Vols., and other small detachments, the entire force on Bay Point Island being 619 officers and men. But of these only 2 companies, consisting of 149 men, manned the fort proper, 83 men Co. H, 9th (11th) S. C. Vols., holding the main work (13 guns), and 66 men, Co. D, 9th (11th) S. C. Vols., holding the outside batteries, (5 guns, sand and hot-shot batteries).

The Confederate naval forces consisted of 3 small side-wheel steamers, each of which carried 2 32-pounders.

The Union fleet making the attack comprised the following:—

Wabash (flagship) frigate,
2 10-inch guns,
28 9-inch guns,
14 8-inch guns,
2 12-pounders.

Susquehanna (side-wheel steamer),
- 15 8-inch guns,
- 1 24-pounder,
- 2 12-pounders.

Mohican,
- 2 11-inch guns,
- 4 32-pounders,
- 1 12-pounder.

Seminole,
- 1 11-inch gun,
- 4 32-pounders.

Pocahontas,
- 1 10-inch gun,
- 4 32-pounders.

Pawnee,
- 8 9-inch guns,
- 2 12-pounders.

Four gun boats, *Seneca*, *Ottawa*, *Pembina*, *Unadilla*, each having
- 1 11-inch gun,
- 1 20-pounder,
- 2 24-pounders.

Vandalia,
- 4 8-inch guns,
- 16 32-pounders,
- 1 12-pounder.

Bienville,
- 8 32 pounders,
- 1 30-pounder.

Augusta,
- 8 32-pounders,
- 1 12-pounder.

Airlew,
- 6 32-pounders,
- 1 20-pounder rifle.

Penguin,
- 4 32-pounders,
- 1 12-pounder.

R. B. Forbes,
- 2 32-pounders.

Isaac Smith,
- 8 8-inch guns,

1 30 pounder, (broadside battery, thrown overboard on way from Hampton Roads).

Union land forces comprised:—

Three brigades consisting of 14 regiments of infantry, 1 regiment of engineers, and battery E, 3rd Artillery; in all 574 officers and 12,079 men.

Narrative of Events

On August 3rd, 1861, an order was issued by the Navy Department, directing Admiral Dupont to cooperate with an army commander (not named) in an expedition against some point in the South.

On September 18th the President, in a letter to the Secretary of the Navy, directed that this expedition be hastened and made ready to sail October 1st, and that General T. W. Sherman be placed in command of the land forces.

On October 12th, an order was issued to Admiral Dupont to cooperate with the army against *some* point to be chosen by him on the southern coast suitable for a naval base. The naval force was determined on and was ordered to rendezvous at Hampton Roads. It was to consist of about 75 vessels, including the vessels of war, transports, colliers, etc.

On October 28th twenty-five vessels (colliers) under convoy of the *Vandalia*, set sail for Savannah to deceive the Confederates as to the real object of the expedition.

The military force in the meantime embarked at Annapolis, where it had previously been assembled, leaving there October 21st, and arriving at Hampton Roads the next day. On October 29th a fleet of some 50 vessels, including naval convoy and transports, etc., left Hampton Roads and set sail for Port Royal, the finest harbor south of Hatteras, that point having been selected by Admiral Dupont and General Sherman.

Every ship that left on this expedition went out with sealed orders, to be opened only in case of separation. The sealed orders directed an assembly off Port Royal.

It was expected that Port Royal would be reached in five days; but in consequence of fierce storms and adverse winds Port Royal Bay was not reached by any of the ships till the 4th of November. During the storms the fleet had been scattered and two boats lost; but by good fortune the number of men lost was only seven.

A reconnaissance was made, and time was taken to buoy the channel. The reconnaissance developed the fact that the Confederates had field works strongly garrisoned, and three small gun boats. It developed also that Fort Walker and Fort Beauregard mounted about 20 guns each; that Fort Walker was the stronger; that the greater part of the guns were on the two sea fronts; and that the northern sea front was the weaker. It was thought proper to reduce the works (Fort Walker) on Hilton Head first; but to do this, fire would probably have to be met from the batteries at Bay Point (Fort Beauregard) also.

The original plan contemplated cooperation of land forces with the navy in making the attack, but this had to be set aside due to the loss of the greater part of the means of disembarkation in the storm. Furthermore the only points where troops could land were 5 to 6 miles (measured around an intervening shoal) from the anchoring place of the transports, altogether too far considering the inadequate means of landing. Accordingly, it was decided to reduce the works by naval attack alone.

Gunboats engaged in reconnaissance were attacked by Confederate gunboats on several days; and on the 5th of November the Federal gunboats attacked the batteries for some 45 minutes, to determine their armament. However, no damage was done the forts except that 3 men in Fort Beauregard were slightly burned by the explosion of a caisson that was struck by a shell.

Meanwhile, on the 4th, 5th and 6th of November, the scattered fleet was coming in; and on the 6th, there being some 45 vessels assembled, the attack could have been made, but it was postponed on account of boisterous weather.

The next day, however, the 7th of November, was fair, the wind had died down and the water was unusually smooth. So at 8:30 a.m. the fleet of war vessels headed by the *Wabash*, bore towards the northwest till reaching the main channel, then moved directly against the Confederate batteries. At 9:25 a.m. a 9-inch Dahlgren gun at Fort Beauregard opened up on the *Wabash*, it being then within range. This first shell exploded near the muzzle of the gun and was harmless. That fire was seconded by Fort Walker and replied to by the ships, the action soon becoming general.

The attack comprised two squadrons—a main squadron advancing in line ahead and a flanking squadron to be thrown off to the northern section of the harbor to engage the Confederate gunboats.

The main squadron, which went in on the left, advanced in the following order:

1. *Wabash,*	46 guns,
2. *Susquehanna,*	15 "
3. *Mohican,*	6 "
4. *Seminole,*	5 "
5. *Pawnee,*	10 "
6. *Unadilla,*	4 "
7. *Ottawa,*	4 "
8. *Pembina,*	4 "
9. *Vandalia.*	20 "
Towed by tug *Smith*	9 "

The flanking squadron:

1. *Bienville,*	9 guns,
2. *Seneca,*	4 "
3. *Curlew,*	7 "
4. *Penguin,*	5 "
5. *Augusta,*	9 "

At noon the following joined the flanking squadron:

Mercury,	–
Forbes,	2 guns,
Pocahontas,	5 "

The plan of attack was to pass midway between Forts Walker and Beauregard, receiving and returning the fire, to a point 2½ miles north of the latter, at which point the flanking squadron was to attack the Confederate gunboats and the main squadron was to round to south by west, closing with Fort Walker, encountering it on its weakest flank, and at the same time enfilading in a direct line its two water fronts. While heading southward the vessels were to be head to the tide, which left them under command with low speed. When opposite the forts, the engines were to slow down just enough to keep the order of battle, and to pass the fort in slow succession. On reaching the extremity of Hilton Head the vessels were to turn north and east, again engaging Fort Walker.

In spite of the fire from the batteries, the fleet soon passed both batteries apparently unharmed, and then returning delivered a terrific fire of shot and shell in the flank and front of the work.

In addition to this moving battery—the fleet—the work was also enfiladed by two gunboats anchored to the north of Fish Hall Creek, and another near the edge of the shoals to the south.

At 10:00 a.m. the fleet turned southward and signaled the *Vandalia* to close up. At 10:15 a.m. the line passed Fort

Walker at 800 yards range, the fleet following the flagship; then it stood to the north and again rounded south, passing Fort Walker at 600 yards.

At 11:30 a.m. the flag of Fort Walker was shot away and the fire of the fort greatly reduced, and as the squadron stood north for the third time, the fire of the forts ceased entirely.

On Fort Walker, during the bombardment, the enfilading fire of the gunboats inflicted considerable damage. The fort had no gun on either flank of the bastion to reply with, for the 32-pounder on the right flank was shattered very early by a round shot, while on the north flank the gun was not mounted for the lack of a carriage. Furthermore, after the fourth shot the 10-inch columbiad bounded over the limber and became useless; one 24-pounder cannon was choked with a shell and was idle during nearly the entire engagement; the shells for the 9-inch Dahlgren were found too large; the ammunition for the two rifled guns did not fit; and two 42-pounders became useless. The 42-pounder and 32-pounder remaining were served till the ammunition failed.

From the beginning of the action the fire of the ships had been endured and replied to. So at 10:30 a.m. the gunners became so fatigued that a greater part of Captain Read's battery, located about 1¾ miles in rear of the fort, were brought in to take the places of the men in the fort.

The attack of the fleet continued unabated, but still no decided damage to any of the ships was noticeable.

At 2 p.m. men were abandoning Fort Walker, having defended it 4½ hours and retiring only when all but three guns on the water front had been disabled and only 500 lbs. of powder remained in the magazine. There had been some 255 men in the fort during the action, at first 220, then later 255.

The fire of the fleet slackened on Fort Beauregard and was concentrated on Hilton Head (Fort Walker). At 2:45 p.m. Fort Walker was in possession of marines and sailors from the fleet, and the American flag raised over the work, and by nightfall a brigade of troops (Wright's) were also landed and in possession.

The retreat of the Confederates from Fort Walker was made in good order, and was made towards Ferry Point, about six miles distant. Fearing that the retreat might be cut off by Federal gunboats at Skull Creek, the island was abandoned and the force concentrated on the mainland.

The attack on Fort Beauregard, though severe, was not so concentrated and heavy as on Fort Walker. In this case the fleet passed northward and hammered the fort at long range. Of the guns of the fort only the following were available, *i.e.* capable of being used against the fleet:

1 8-inch Rodman, bored for 24-pounders, rifled,
2 42-pounders,
1 10-inch columbiad,
2 42-pounders, reamed to 8 inches,
1 32-pounder, in hot-shot battery.

On Bay Point, as stated, were some 600 men, of whom 149 were in the works; the troops outside the works were entrusted with the protection of the eastern part of the island and with the defense of the bastion line at Island Narrows, where an attack was expected from the enemy.

An attempt was made to send an additional company from Fort Walker by steamer, but the company had to return, finding itself in danger of being cut off by the fleet.

During the progress of the action it was observed from Fort Beauregard that Fort Walker was silent and that a boat from the fleet was approaching it. So arrangements were then made to retreat from Fort Beauregard towards the Narrows, all property being abandoned on account of lack of roads on the island. The force finally retreated to Beaufort, getting there on Friday, November 9th.

The commanding officer, Colonel R. G. M. Dunovant, states in his report that his reasons for retreating were that he had received no instructions as to the mode in which the island should be defended, nor the contingencies upon which it should be abandoned; and that there were no arrangements, by means of signals or otherwise, for receiving orders from headquarters. Having been totally without information of any plan devised, or facilities provided, for retreat in case of disaster, he had felt that circumstances imposed the obligation of endeavoring to secure some means of carrying out the evacuation of the island, should it become necessary, so he had gathered various boats, etc., and made the necessary plans and arrangements. From the nature of the attack the forces at Fort Beauregard were the only active participants. The last gun was fired from the fort at 3:35 p.m., but was not replied to by the fleet. As Fort Walker had been abandoned and as the remaining fort could no longer protect the harbor, orders were given for the withdrawal of the garrison before its retreat might be cut off, the greater part of the powder was destroyed, guns spiked, and about 4:45 p.m. march was taken up for Eddings Island.

One of the columbiads was fired 57 times, others not quite so often. Fire was directed exclusively at the larger vessels, and hot-shot was fired from the 2 42-pounders on the front face.

The fuzes of the 8-inch shell being defective—igniting too soon—rifle shell had to be refitted to the gun after 1 or 2 rounds. The gun itself exploded on firing the 32nd round, slightly wounding all the men in the detachment. The explosion was presumed to be due to the gun having been loaded while hot, and then allowed to cool, the strains set up by the contraction resulting in explosion when the piece was fired.

The hot-shot battery fired only a few rounds, but was so exposed during the cannonade that it could not be served.

Recurring to Fort Walker, Colonel Wagener, of the 1st Artillery (Confederate), states in his report that the works of the fort were manned in one and one-half minutes after beating the long roll; that during the fight there was just sufficient motion in the air to blow the smoke of the ships' guns in the faces of the land gunners, preventing sight except by glimpses; that sailing vessels were towed by steamers, making their maneuvers extremely accurate; that ships were constantly changing their range; that the land forces were much hampered by not having a battery on the bluff which commanded the flank; and that the ships took position in the mouth of the creek, giving the forts a raking fire, dismounting guns, wounding men and doing great damage.

For some minutes after 9 a.m. the fire of the forts was very slow, and the range to the ships too great. Shortly after 9 a.m. the ships reached a position in front of the batteries at about 1¼ miles, delivering a slow and well directed fire and showing that they were going past the forts. Rapid fire and hot-shot from the forts made little impression on the ships, due to the long range and to the ships' being in constant motion. So in a few minutes several ships got by, and three took a position enfilading the batteries from the northwest flank, while others, which were not yet in action, took up a course opposite the south east front. The *Wabash*, the largest ship, returned down the front delivering an accurate fire at short range, supported at longer range by two other ships. When these maneuvers had been executed and positions established, Major Hagar says: "The fort was simply fought as a point of honor, for from that moment we were defeated, excepting perhaps by providential interference."

At 11:00 a.m. it was reported that the Bay Point batteries had been silenced. At 1 p.m. it was reported that nearly all the ammunition was expended—there being only ten or eleven rounds for the 32-pounders left—and it was thereupon determined by the Confederate commander to evacuate the work; so under cover of the fire of some of the guns the troops were withdrawn, and about 2 p.m. the last detachment was ordered from the guns.

Of the channel battery, only three guns were in condition to continue the fight, which was hopeless.

The defense of Fort Walker involved two propositions—one, to repel an attack from the fleet, and the other, an assault by the beach from the troops in the transports.

As an offensive work Fort Walker found itself unequal to the immense force brought against it. As a defensive work it accomplished its purpose by so well protecting the lines of the garrison that, after sustaining an incessant fire of shot and shell for nearly five hours, only ten of the garrison were killed. This number would probably have been less, had the traverses on the water front been practicable.

At the close of the engagement the fort had sustained but little damage, although hundreds of shot and shell were buried in the traverses and parapets.

Thus it will be seen that this entire action was carried out by the navy, the troops accompanying the fleet being but spectators. After the reduction of the works they were taken possession of by the army, which found the works on Hilton Head severely crippled, guns dismounted, etc.

At sunset the fleet found Fort Beauregard abandoned, and raised the flag over it the next day.

There were captured some 52 pieces of ordnance, ammunition, etc.

CASUALTIES

Fleet:	
Killed	8
Severly wounded	7
Slightly wounded	17
	31
Fort Walker:	
Killed	10
Wounded	20

Fort Beauregard:		
Wounded	13	
15th S. C.:		
Killed	1	
Wounded	15	
Captured	3	(sick in hospital)
Missing	4	

or in all:

Confederate loss:	
Killed	11
Wounded	48
Captured	3
Missing	4
	66

The *Wabash* is struck nine times in the hull and the spars, and many more times, at least 20, through the rigging.

Curlew: 1 shot strikes Parrott 20-pounder, breaks off 18 inches of muzzle, disables gun. Ship fires 102 shot, 33 shell.

Pembina: Not hit.

Augusta: 1 hit; picks up disabled *Penguin* and tows her throughout the engagement.

Vandalia: No data.

Penguin: Boiler struck by shot from Fort Beauregard; then shot from Fort Walker carries away tiller chain; ship towed by *Augusta.*

Ottawa: Struck by 32-pounder from Fort Beauregard; then takes up position enfilading Fort Walker, disperses infantry with shrapnel; 500 yards range.

Forbes: Not hit; expends 43 shell.

Isaac Smith: Not hit; fires 28 shells at works, 3 shells at Confederate gun boats.

Unadilla: Hit six times; expends 33 11-inch shell, 37 20-pounder shell.

Seneca: Not hit; expends 63 11-inch shell, 33 Parrott shell, 12 24-pounder shrapnel.

Pawnee: 7 hits from Fort Beauregard.

Seminole: 6 hits; expends 43 11-inch shell, 82 32-pounder shell, 60 round shot.

Susquehanna: 10 hits in hull, 20 hits aloft; expends 2 shot, 424 shell.

Mohican: 5 hits in hull, many times aloft.

Bienville: Hit more than 3 times; expends 84 32-pounder shot, 39 32-pounder shell, 62 rifle shell.

Pocahontas: Expends 24 10-inch shell, 37 32-pounder shell, 5 32-pounder shot, 4 15-pounder shell.

Drayton, commanding the *Pocahontas*, says in an unofficial letter that forts fired wildly, all shot over, and ships did likewise. Forts not damaged in least, only three guns knocked over, *Pocahontas* not hit except aloft. Many shot found as much as 1½ miles inland.

Speed of vessels six miles.

COMMENTS

1. Earth works of forts were of faulty construction; all guns being mounted in barbette, which, on low sites, affords no protection to gun or to personnel.
2. Entire sea battery of Fort Walker could be enfiladed by a position north of it, as was actually done.
3. There were no traverses between guns.
4. Of the number of guns on hand, too many were mounted on the land front.
5. No mortars in the armament.
6. No effort made to close the channel by obstructions, mines, etc.
7. Precipitous abandonment of works.
8. No cooperation, apparently, between forts.
9. No system of inter-communication.
10. Lack of definite orders, or total absence of orders.
11. Disappearance of Confederate commander during the engagement, and then "lost in the woods" (see official report, Rebellion Records).
12. Poor shooting on both sides, fleet fired presumably over 2000 rounds at ranges of 500 to 1000 yards.
13. Usual lack of ammunition assigned as the reason for quitting Fort Walker.
14. Guns plainly visible, and only four dismounted by fire of fleet. Preponderance of fire of the fleet over that of the forts should have kept gunners on fleet reasonably cool.
15. Poor fuzes complained of at Fort Beauregard.
16. Infantry used as artillery at Fort Beauregard.
17. Shells found not to fit guns in action.
18. The forts' shooting seemed to be better than the ships' and yet fired under tremendous odds, due to ships' great preponderance in weight of metal thrown.

19. Insufficient personnel manning guns at Fort Walker, necessitating additional troops being brought in during the action.

20. Use of infantry fire by troops north of Fort Walker against ships.

21. An example of a pure naval action, showing abandonment of works due to fire effect alone.

AUTHORITIES

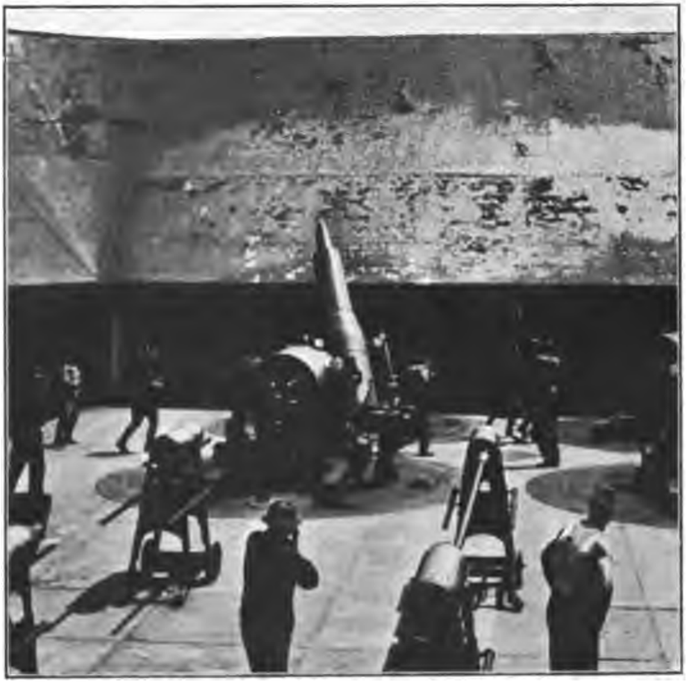
Official Records of the Union and Confederate Armies, Series I, Vol. VI, pages 3-30.

Official Records of the Union and Confederate Armies, Series I, Vol. 12, pages 261-317.

Battles and Leaders of the Civil War, Vol. I, pages 678-685.

THE EXIT OF A PROJECTILE FROM A MORTAR

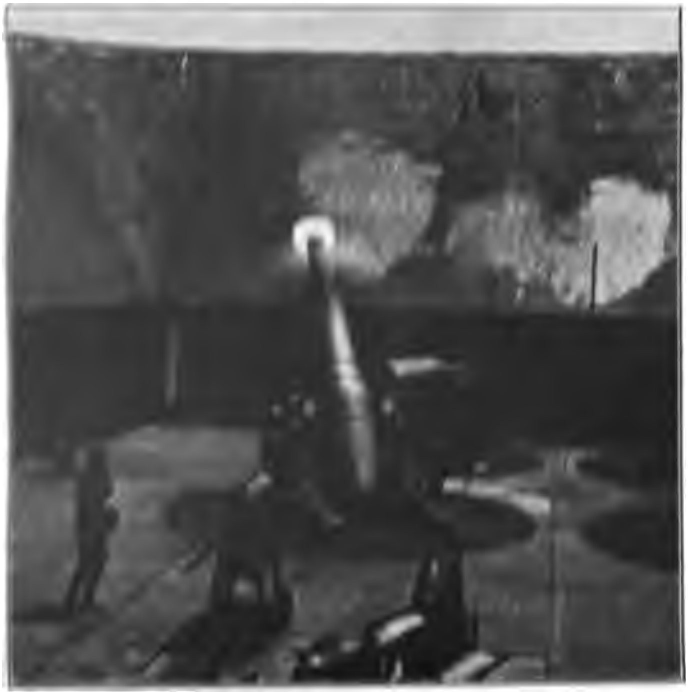
Through the courtesy of the Department of Enlisted Specialists, Coast Artillery School, the readers of the JOURNAL are, in this issue, afforded the opportunity of observing in detail the phenomena attendant upon the discharge of a projectile from a mortar.



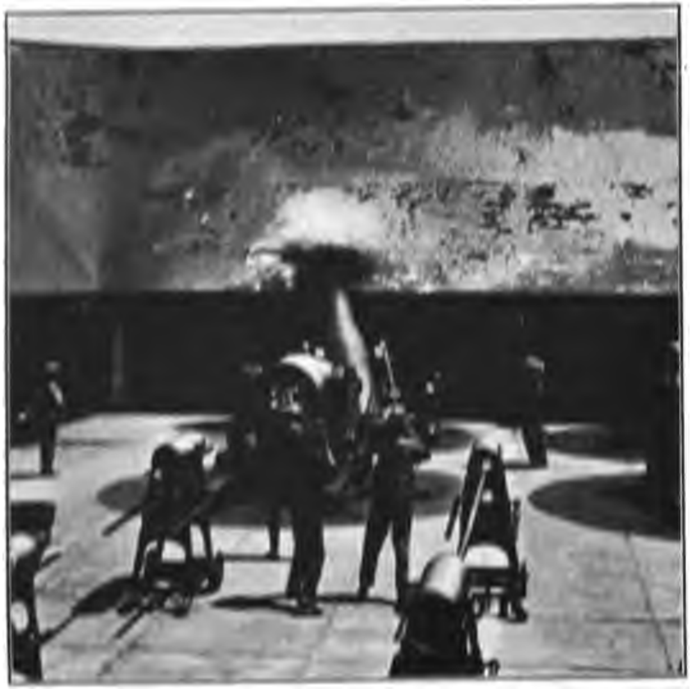
Department of Enlisted Specialists, C. A. S. (*Copyrighted*) 1180

The phenomena are shown in seven photographs which were obtained by means of an electrical device so placed as to cause the shutter of the camera to be operated by the mortar in recoiling.

The device used in this case was caused to operate upon the *break* of the electric circuit, the setting being varied in order to photograph successive phenomena; and while such a

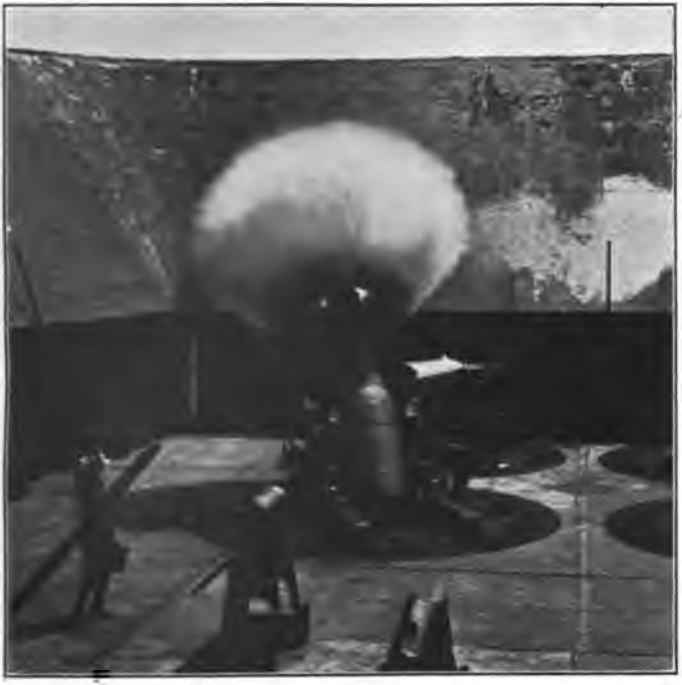


Department of Enlisted Specialists, C. A. S. (Copyrighted) 1181

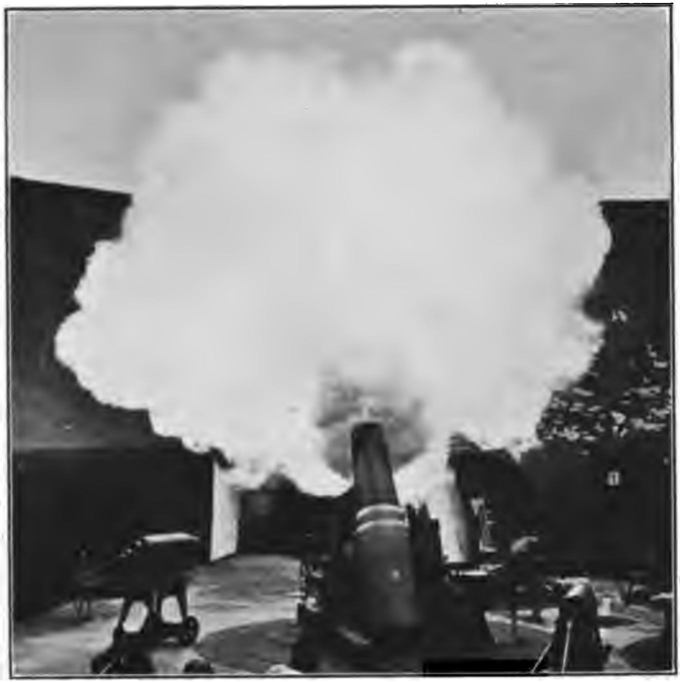


Department of Enlisted Specialists, C. A. S. (Copyrighted) 1182

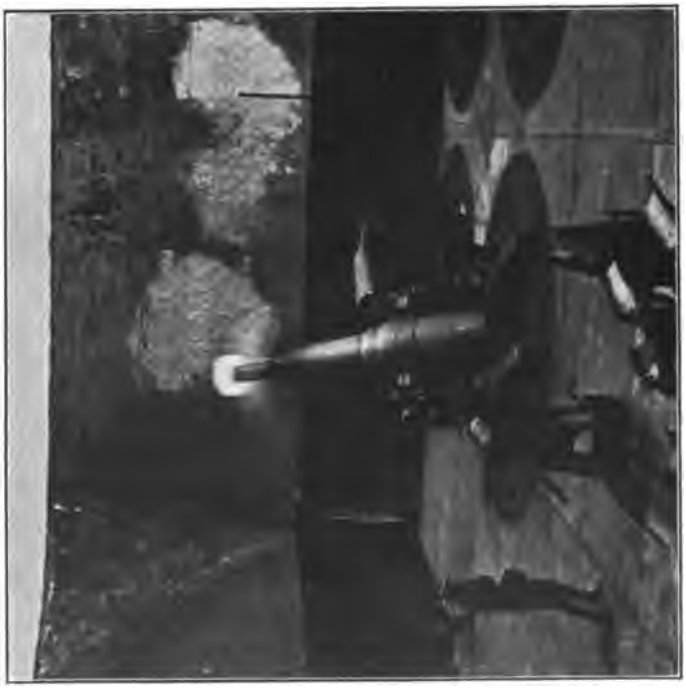
THE EXIT OF A PROJECTILE FROM A MORTAR



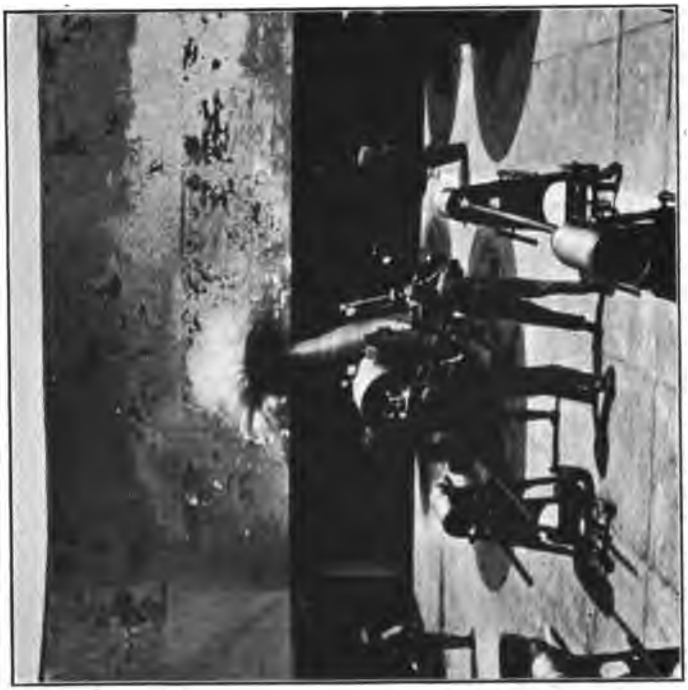
Department of Enlisted Specialist, *C. A. S.* (*Copyrighted*) 1183



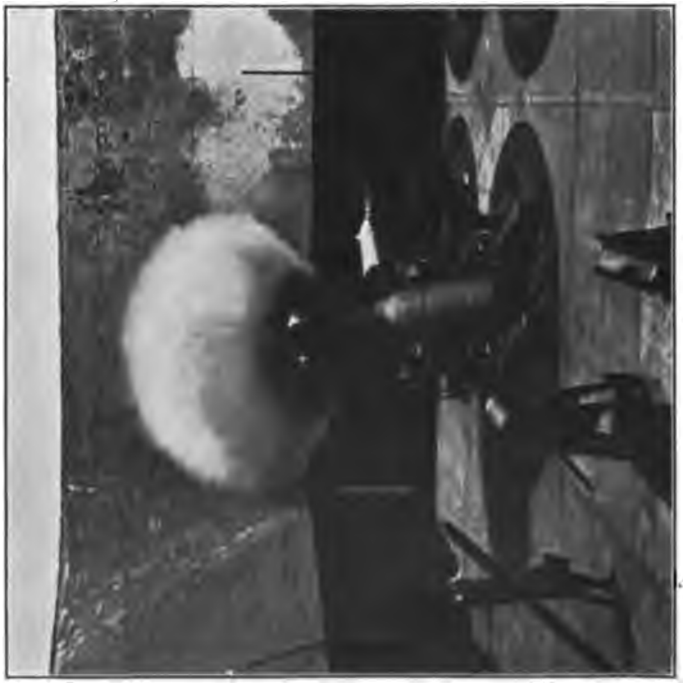
Department of Enlisted Specialists, C. A. S. (*Copyrighted*) 1184



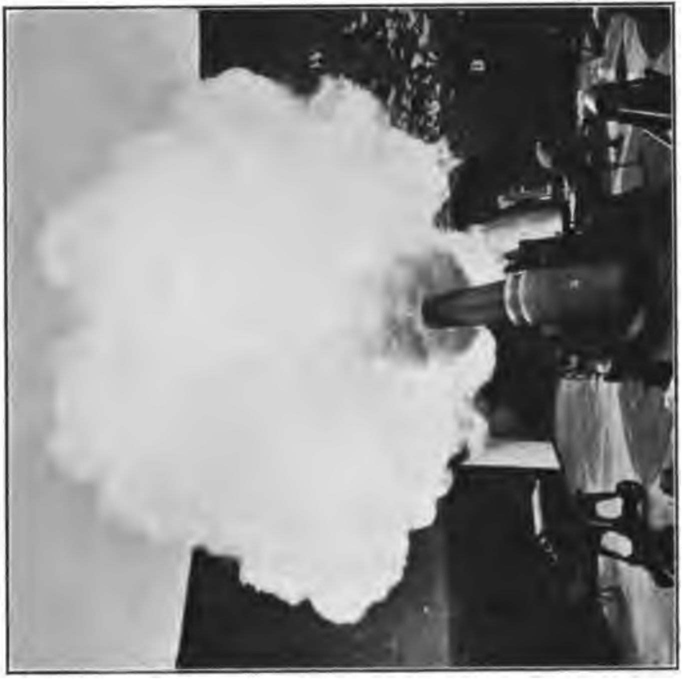
Department of Enlisted Specialists, C. A. S. (*Copyrighted*) 1181



Department of Enlisted Specialists, C. A. S. (*Copyrighted*) 1182

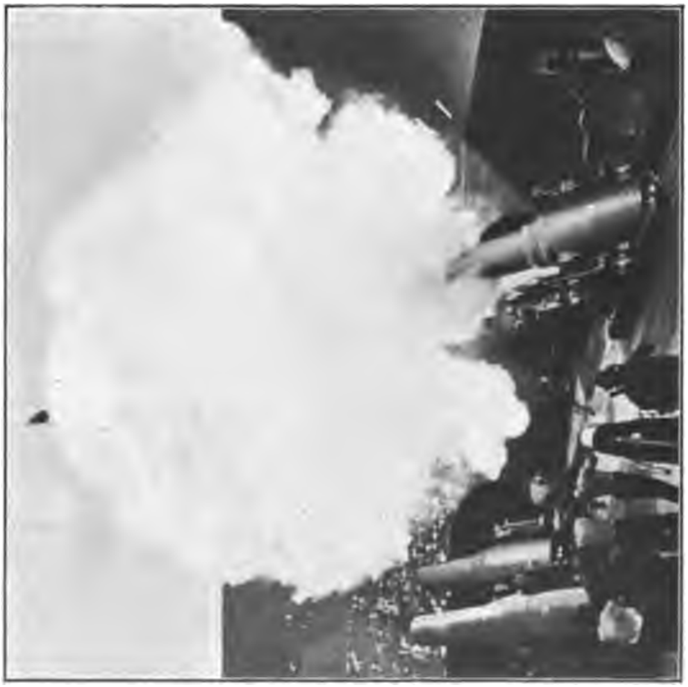


Department of Enlisted Specialists, C. A. S. (*Copyrighted*) 1183

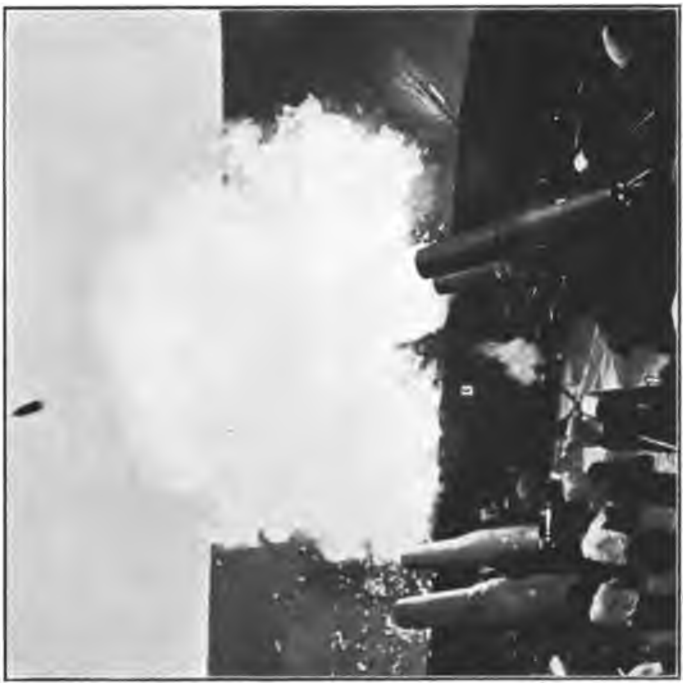


Department of Enlisted Specialists, C. A. S. (*Copyrighted*) 1184

THE EXIT OF A PROJECTILE FROM A MORTAR



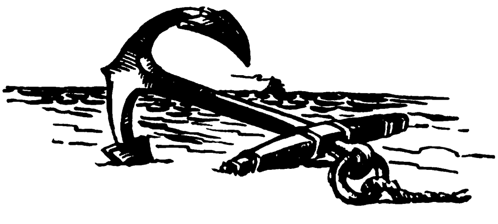
Department of Enlisted Specialists, C. A. S. (Copyrighted) 1185



Department of Enlisted Specialists, C. A. S. (Copyrighted) 1186 device may not result in photographs of phenomena the instant of occurrence of which are separated by equal intervals of time, yet a modification of the device introducing certain principles of the chronograph would give such results.

The excellent definition of the photographs was obtained, in spite of the fact that the mortar pit was shaded by trees, through the use of a shutter, rated at $\frac{1}{5000}$ of a second, which had been especially manufactured for this kind of work, and through the use of an appropriate lense and an extremely sensitive plate.

The ring of gas about the projectile in rear of the cap which is observed in the second photograph, is believed to have been due to windage resulting from the projectile's not having been properly seated; for it was noted during the practice that such rings appeared on several occasions when the ramming was known to have been faulty. However, the faulty ramming and the appearance of the ring may have been mere coincidence, since no scientific investigation of the relation has been made.



PROFESSIONAL NOTES

AIRPLANES IN COAST WARFARE

By Lieutenant CHRIST, 2nd Hindersin (Pommerschen) Regiment Foot Artillery

Translated from the German by Lieutenant WALTER J. BUTTGENBACH, Coast Artillery Corps, for the Journal U. S. Artillery

Airplanes have already their sphere of use in land operations; while, on the other hand, the question of their use in naval warfare is still in the experimental stage, all great powers, including Germany, being busily engaged experimenting.

These experiments have two main objects in view: first, the airplane must be able to ascend from the deck of a ship and be able to return to it again; second, it must be able continually to report its observations by wireless telegraphy.

A favorable ending of these experiments is looked for. According to reports from North America the ascent and descent of an airplane from a deck of a warship is already an accomplished fact; and there was exhibited at the last Airplane Exhibition in Paris, 1911, an airplane with a wireless system of communication.

The coast defense will seek to avail itself of the advantages of airplanes, since they may play an important role in coast warfare. And it is proper that we consider the question in which way use will be made of airplanes, by the attacker as well as by the defender.

The use of airplanes in coast warfare will be particularly favored by the regularity of air movements and the clearness of vision over the sea. On the other hand its use, as on land, is much hampered by fogs, and, perhaps, even more hampered, due to lack of any means of orientation; and its use is wholly prevented by strong winds. Only with such limitations can the following considerations govern.*

THE ATTACK

The distribution of airplanes on the attacking ships may be such that each large vessel carries one or more airplanes on it. Or it may happen that all airplanes assigned to a fleet shall be carried by one ship especially arranged for sucn purpose.

On approaching the hostile coast, the fliers of the attacking fleet receive their orders for the distant reconnaissance. They seek to locate definitely the base of the opposing fleet and thereby protect their own. When they locate hostile reconnoitering vessels, they at once make report to their own torpedo boats and small cruisers. In this way it may become possible for them to drive away the opponent and break up his reconnaissance. Thus the airplanes form the first reconnoitering bodies in front of the line of torpedo boats.

---

* Written December 1911.

Should the attacking fleet engage in a blockade, the airplanes can take over part of the service of observation and reconnaissance; for if they are in the first line they can send in reports of troop movements on land that could not be definitely established by ships. As the fliers can at most remain six or seven hours in the air, it will be necessary that they be frequently relieved.

If there be in the blockaded harbor a hostile fleet, it will be necessary to ascertain the number of vessels, their condition, whether any are lying in dry dock making important repairs, and whatever other work may be seen. At the same time the airplanes may obtain reports of sorties which appear to be planned, and thus simplify very much counter measures to be taken.

It we consider only a commercial blockade, whether against a single harbor or against an entire coast line, airplanes may be very advantageously employed. Ships that attempt to break through the blockade will be seen at great distances and reported. The blockade will thus require only as many vessels as appear to be necessary for pursuit, the heavy service of observation being for the greater part taken from the men and ships.

Thus the blockader will, through airplanes, extend his reconnaissance area far inland and will achieve a great saving in the use of observation vessels and in the exhausting duties of his personnel. This is especially the case in a commercial blockade.

Should the fleet advance to the attack of coast fortifications, the airplanes will be charged with the duty of near reconnaissance.

They will seek to determine definitely the position of obstacles; as, for instance, underwater dikes, sunken vessels and mine fields. In the case of the latter, knowledge as to the direction of channels which might be used by the blockaded fleet is of especial value to the attacker.

As the determination of the locations of coast batteries from the sea is particularly difficult, it is of great importance for the attacker that he have exact points of reference, as, for example, land marks, light houses, high chimneys, church steeples and the like. But as the defender will have demolished these as far as possible, the fliers may be given the problem of connecting the locations of batteries with new points of reference.

In the same manner airplanes may be given the task of reporting whether permanent batteries have auxiliary works near them.

In carrying on the artillery combat the possible uses of airplanes are much increased. For the observation of hits they can be of great use, even if their work be limited only to the general character of the shots, as for example: "Against the battery of the eastern slope of the woods the majority of shots fall short, or over, or are correct."

Airplanes will be of particular value to the attacking fleet in combating their most dangerous opponent—high angle fire batteries; these are under cover, distant (in some cases over 2 km.) from the shore, and can hardly be silenced by the fire of the fleet, for observation of fire against them from a ship is hardly possible. A scattering fire between wide limits that requires much ammunition and only promises small results is scarcely practicable, considering the small ammunition supply of a vessel and the quick deterioration of the bores of the larger guns.

When the ships have found the range, the flier can aid in the distribution of fire by reporting which targets are receiving unnecessarily heavy fire or which require additional fire.

A flier should be designated for each target, for the observation of many targets is very difficult, as the airplane cannot keep itself in the air at a fixed point. A relief will hardly be necessary in the usual rapidly passing artillery combat.

Should the attacker proceed to force his way through the fire zone and the mine fields, the reconnaissance of these fields is of great value in order that the fleet may not strike them where not expected and thus be held in the most effective fire zone of the coast artillery.

If the fleet has in view the bombardment of important military works in rear of the fortifications, such as docks, arsenals and the like, without attempting a decisive action with the coast batteries, the airplanes can here also be of great use in reconniassance, in aiding observation that is particularly difficult and important, and in distribution of fire.

In landing operations, the flier can definitely determine if troops are nearby to offer resistance, and can determine their strength; and, in case it be necessary, can reconnoiter points that are less strongly manned.

Thus we have the following uses of airplanes for the fleet: the possibility of using for a designated object a smaller number of vessels and with less fatigue on the part of the personnel; better service of reconnaissance and observation; the possibility of observing greater land areas; and considerable enlargement of operations against coast artillery.

The defenders will suffer losses notwithstanding their former preponderance over the fleet, unless they find the necessary means to combat the airplanes.

THE DEFENSE

Under present day conditions, the coast defenses must reckon with unexpected attacks, made even before the declaration of war. Therefore it seems desirable that the airplanes attached to the seacoast fortifications, at times of tension in diplomatic affairs, make reconnaissances far out to sea as soon as the place of assembly of the hostile fleet is no longer definitely known. In this case, a systematic examination of the various portions of the sea is to be recommended is so far as it may be necessary or possible.

Upon the approach of the fleet, reconnaissance by airplanes becomes simpler, and then includes the question as to the distance of the fleet, its strength, composition, formation, speed and direction of movement. Thus the airplane can save the threatened works from surprise and give them urgently needed time for preparation. Besides, it can indicate to its own torpedo and submarine boats the direction of the enemy, and can warn them in case the enemy is to attack with a greatly superior force. Such information is of particular value for submarines, as due to their low speed they can easily fall a victim to torpedo boats and cruisers.

In a blockade, the flier can definitely locate the position of the enemy, discover gaps that may exist at times in his observation line, and detect lack of watchfulness, thus giving an opportunity to blockade runners to break ough or for a blockaded fleet to make an attack. In case of sorties there will be reported to the torpedo and submarine vessels the positions of the enemy, and necessary warning given them.

In the attack, the airplanes of the defender can definitely establish whether a portion of the enemy is holding the coast artillery so as to cover landing operations, or if individual vessels are designated to run by. In the artillery combat itself it has no value, as observation from land toward the sea is good.

In a run by, reports of the airplanes will probably be too late, in view of the great speed employed in the advance.

Also in firing upon important works near the coast, the use of airplanes by the defense will hardly come into consideration.

As protection against attempts at landing, the airplane is of great value as it can definitely determine the approach and strength of the enemy. Thus it will prevent the posting of coast observation troops in the wrong place and in insufficient strength.

On the whole, however, the use of airplanes in coast defense is not so great as in the attack, since the possibilities and opportunities for its use appear to be considerably less.

COAST DEFENSE MEASURES AGAINST AIRPLANES

As measures to be employed in coast defense against hostile fliers there may be considered the equipping of coast works with airplanes, the locating and building of batteries to attack hostile airplanes, and the overhead armoring of battieres that up to this time have not been armored.

As an offensive aid may be considered its own fliers. Fliers are, under any and all considerations, to attack hostile airplanes, driving them off or destroying them. If for the purpose, the use of automatic guns, hand grenades, or any other weapon do not suffice, then the flier is to destroy his opponent by running into him, sacrificing to that end his own life; for the loss of one airplane is far more serious to the fleet than to the defense, since the airplane is more important to the fleet in reconnaissance and observation, and since for it a reserve of machines is a far more difficult problem.

It is, therefore, to be recommended that the coast works be supplied with a permanent depot, having one or more airplanes equipped with trained fliers and observers.

As defensive measures against airplanes, automatic guns may be of use. These are to be posted on the flanks of the works and in the center; also, specially near the entrance. As the fliers will generally appear singly, it will be sufficient to have two guns in a position, ready for action. The emplacements which will be placed on the shore in order to afford opportunity for use at the earliest moment, are to be armored and covered from sight from the sea and from above. The extreme range of the guns must be not less than about 10,000 meters, so as to be able to keep the airplanes at a distance in order that a thorough reconnaissance may be impossible. There will be demanded, then, guns of 9-10 cm. caliber. It will be desirable that the projectiles have tracers so their trajectories can be recognized. Each group is further to be equipped with range finders to serve for accurate range finding at the longer ranges.

If the fortifications are exposed to attack by land, then defensive guns with range finders should be erected at appropriate distances.

For important batteries not under armor, armor protection will be demanded.

In the use of these various means it may be expected that the operations of airplanes against coast works will be so far limited that the latter will be able to hold their former advantage over the fleet.

—*Jahrbucher fur die deutsche Armee und Marine*, June, 1912.

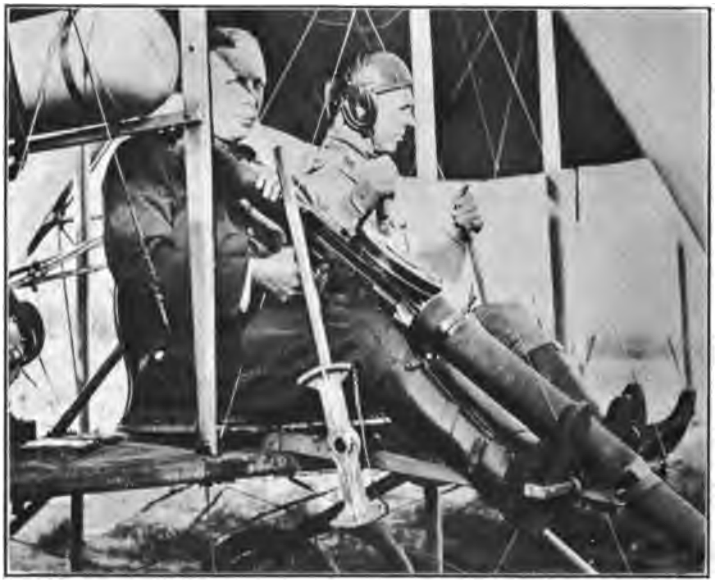
✣ ✣ ✣

THE LEWIS AEROPLANE GUN

By Capt. Charles De Forest Chandler, Signal Corps, U.S. Army, in Charge

Chief Signal Officer of the Army.
Sir:—

I have the honor to report that on the 7th and 8th instant the machine gun invented by Lieut. Colonel Lewis was tried from an aeroplane at the Signal Corps Aviation School, College Park, Md.



1187

Captain Chandler ready to begin aeroplane firings employing the Lewis gun at College Park, Maryland, June 8, 1912

The gun is air cooled, weighs 25 lbs. 6 oz., and shoots the service small-arms ammunition. The rate of firing can be adjusted by controlling the gas used in the operation from about 300 to 700 per minute. Fifty cartridges are placed in a drum and this drum slipped over a spindle on the gun. The firing at College Park was done with the gun adjusted for about 500 per minute, which, with continuous firing, would empty the drum in six seconds. On the 7th instant Colonel Lewis gave me instructions in operating the gun, and I fired once on the ground for practice. The control and operation of the gun appeared so simple that I had no hesitancy in trying it immediately from an aeroplane. The Wright Type B aeroplane was used, with Lieut. Milling as aviator.

On account of my lack of experience with this gun and possible endangering the lives of the officers at the Aviation School, the first experiment was made from an altitude of only 250 feet. The target used was a piece of cloth about 6 feet by 7 feet. The speed of the aeroplane being about 42 miles per hour, the target was passed in about 1-10 of a second, therefore it was necessary to begin firing just before reaching the target and discontinuing as soon as it was passed. Three trips of this kind were made across the target. Upon examination five bullet holes were found in the target and there were other holes in the ground a short distance in front of the target, all within an area of about 4 yards by 20 yards. No sights were on the gun at this trial; sighting was accomplished by looking over the barrel of the gun. The second trial of the Lewis machine gun was made from an aeroplane on the 8th instant, the target having a size of 2 yards by 18 yards, and the firing was done from an altitude of about 550 feet by the same officers and aeroplane. Forty-four shots were fired at the target, five of which hit and the others fell a short distance beyond the target. The experiments on this date were witnessed by Colonel Scriven, Signal Corps, all officers of the Aviation School, and a number of newspaper representatives and other civilians who were interested.

Very respectfully,
C. DE F. CHANDLER.

—*The Aero Club of America Bulletin*, July, 1912.

✣ ✣ ✣

SIGHTING APPARATUS FOR AERIAL CRAFT

14,180* (1911). A. S. Marks, London. The instrument composed of adjustable scales and the optical apparatus described in this patent are designed for determining the moment at which a shell should be released from an air vessel in order to strike a given object.

An elevation and plan of the scaled instrument are illustrated in Fig. 1. The optical device shown in Fig. 2 is used for judging the speed of the airship. Figs. 3, 4 and 5 are diagrams referred to below. The apparatus (Fig. 2) which is employed for determining the speed of the air vessel consists of a camera or similar optical projecting apparatus carried by the air vessel so that the line of sight is perpendicular to the line of flight. For convenience in operation the casing is divided into two parts containing the lenses *o p*. The mirror *q* is fixed in the lower portion of the casing to deflect the rays in the proper direction to be received by the eye of the operator. A prism would be equally convenient for this purpose. When the apparatus is moved in a direction towards an object, the image travels in the same direction as the object itself appears to travel. The lens *p* is preferably provided with fiducial lines, *r s* determining the limits of the field. The distance between the lines *r* and *s* is adjusted in relation to the focal lengths of the lenses so that the actual distance travelled over the ground by the air vessel at a particular height is represented by the virtual distance *r s*, and is a known factor of the height. If the focal length is double the length between the lines *r s*, and the air vessel is at a height of 1,000 feet, then the air vessel would travel a distance of 500 feet during the time which it took the image of an object to travel the length *r s* on the lines or screen *p*. By means of this instrument and a stop-watch, a ready means is provided, it is claimed, for ascertaining the speed. If the object observed were also moving, the observed speed would be the difference or sum of the two speeds.

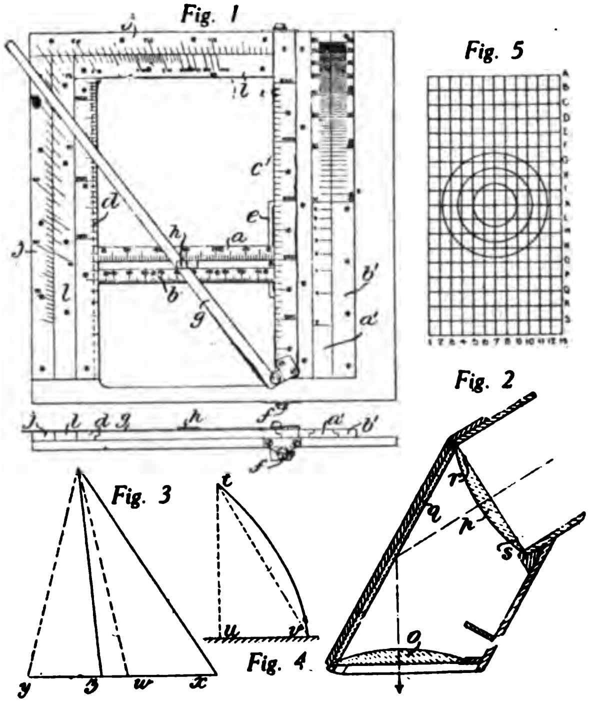
---

* English patent number.

To avoid calculations unsuitable for the circumstances the speed may be graphically determined by the instrument illustrated in Fig. 1. It is provided with the pair of scales of velocity *a* and *b* and the vertical scales of height *c* and *d*. These may be colored differently as a help to easy reading. The scales *a* and *b* are adjustable with regard to the vertical scales *c* and *d*. They slide and clamp on the rod *f*, which is fixed to the vertical scale of height *c*. The pointer *g* is pivotally mounted on the scale *c*. A rest for the pointer is formed in the slotted block *h*, which is adjustable in the space between the velocity bars *a* and *b*. The two scales *j* and *l* indicate respectively angles and speeds. The observed time taken by the image of an object upon the earth to traverse the screen from *r* to *s* is noted, and the sliding piece *h* is brought opposite to this observed time upon the scale *a*, the graduations of which indicate time in seconds. The velocity bar has previously been set to the height on the scale *c*. The barometer is consulted for height. On bringing the pointer *g* to its position of rest within the sliding hook *h*, the speed of the air vessel is recorded upon the inner scale *l*, the graduations of which indicate miles per hour. The block *h* is then set to this speed as marked upon the scale *b*, the graduations of which also indicate miles per hour the velocity bar having previously been set to the height of the air vessel as marked upon the scale *d*. When the pointer *g* is again brought to rest within the slotted block *h* the required angle of descent will be given upon the scale *j*, the graduations of which indicate the measure of the angle in degrees. The angle of descent is the angle between the imaginary lines *t u* and *t v*, Fig. 4. The objective is at the point *v* upon the earth's surface while the air vessel is at the point *t* at the moment when a missile should be released to strike the object *v*. Having ascertained the angle of descent, the optical apparatus is set to the required angle so that when the object to be hit comes into the center of the screen, that is theoretically the moment at which a missile should be released from the air vessel.

In practice the position on the screen required to be occupied by the image would be modified to a certain extent by air resistance and wind pressure. In order to determine the exact point on the screen to be occupied by the image, the airman is provided with a double slate, one side of which is identical or proportional in size and shape to the portion of the lens *p* included between the fiducial lines *r* and *s*. It is ruled and marked as shown in Fig. 5. It is assumed that for practical purposes the amount of deflection of the projectile due to windage is proportional to the distance through which the projectile travels. The path of a projectile dropped from an air vessel in a wind forms a constant angle with a perpendicular dropped from the vessel. An airman knowing the velocity of the wind would consult the tables given on one side of the device to determine the degree of deflection of the path of the projectile from the normal due to the wind. He would then on the reverse side of the slate select the circle corresponding to this degree and set out the point on the circle corresponding to the direction of the wind at which it would be necessary to aim in order to strike a point at the center of the circle. This point may then be transferred to the screen of the actual sighting apparatus by placing the cross wires of that apparatus on the figures corresponding to the figures marking those of the lines drawn across the circles vertically and horizontally as in Fig. 5, which intersect in or near the point required.

Under certain conditions it may be found impracticable for the air vessel to pass over a moving object for the purpose of ascertaining its speed in relation to the speed of the air vessel. The observation would then have to be made when the object was some distance ahead, the speed-measuring device being tilted to the necessary angle for obtaining such an observation. Such a case is diagrammatically illustrated in Fig. 3, where *y w* gives the virtual distance from which the speed is calculated, while *z x* is the actual distance, and in order to make the necessary correction for the tilting of the speed-finding device, the scales *a′* and *b′* (Fig. 1) are provided. They are movable in relation to one another, so that the necessary correction may be made for finding the actual speed. Accepted June 20, 1912.



—*Arms and Explosives*, August, 1912.

◆ ◆ ◆

AERONAUTICS. AN INTERESTING INVENTION

Translated from the French by Lieutenant S. S. Winslow, C. A. C., for the Journal U. S. Artillery

It is reported that M. Berthelot, a captain at Vesoul, has just completed the construction of a sighting device for use in throwing bombs from airplanes and dirigibles. It consists of a complicated form of pendulum, with a truncated cone enclosed in a cylinder.

On account of the special arrangement and the use of a sufficiently dense liquid, one that will not freeze in winter, and of the protection of the pendulum from the air, giving a little more stability, it remains constantly vertical. The inclined positions taken by the machine are quickly registered but vibration does not affect it.

At a height of 1000 meters the field of view has a radius of 200 meters, in front of the vertical. It also gives lines of sight for different inclinations, in front of the vertical.

The field of view and the lines of sight permit the operator to recognize his target in advance, and tell him when to release his projectile, correcting for speed, altitude, etc.

While the sight lacks a special indicator for speed, it permits its calculation by measuring the distance passed, as indicated by the part of the field of view passed over, the height of the machine being known.

There have been computed range tables to avoid calculation and to permit rapid operation. The eye and the hand must act simultaneoulsy, for the slightest delay causes big errors. This is on account of the speed of airplanes, the slowest of which make from 20-25 meters per second.

—*La France Militaire*, July 19, 1912.

◆ ◆ ◆

SOME CONSIDERATIONS WHICH AFFECT THE TRAINING OF THE R. G. A. IN COAST DEFENSE

By Captain C. N. Buzzard, R. G. A.

To anyone who has watched the progress made in the training of our army during the last decade, it must be apparent that the point which has of late received the most attention, and which is still of growing importance, is the necessity for promoting co-operation amongst the various arms. One has only to visit an artillery practice camp, for instance, to realize that almost every tactical scheme under which gun practice is carried out, is based on the principle that infantry is the arm on which the ultimate success of an action depends; that it is the duty of field artillery, and, indeed, of other arms of the field army, to render all assistance in their power to the infantry, to enable them to cope with the difficulties which confront them. Officers, too, are encouraged to study the methods in use in arms other than their own, and the interchange of ideas and views tends to promote general knowledge, and, perhaps we may say, a broader minded way of looking at things military.

Turning now to the coast defense officer, and regarding him as such, and not as an embryo field army officer, which he apparently sometimes hopes to be on the outbreak of serious war, we find that, so far as co-operation is concerned, he is linked with two very different services.

In the first place, he is concerned, though somewhat indirectly, with naval strategy and tactics, not only because coast defense serves as a second line to our navy, but also because ships presumably will be his principal opponents. Regarding this maritime co-operation more will be said later on.

In the second place, he should be well acquainted with the tactics of field units so far as they affect forces landed for specific purposes, and the measures taken to oppose them. It may be urged that infantry are told off for the defense of batteries, and that their duties have little to do with those of the garrison gunner, whose *raison d'etre* is the engagement of ships of war; but we need only examine the defenses of any naval base to be convinced that the R.G.A. officer cannot dissociate himself from the land defense of his batteries. Fire commanders and battery commanders are, like any other officer in the army, liable to find themselves in command of detached forces engaged in a struggle with an attacking enemy.

If anyone will imagine himself charged with the task of attacking a fortress, British or foreign, it would be surprising if he did not come to the conclusion, in most cases, that the best chance of success lay in combined operations by land and sea. He who has experienced, even only at maneuvers, the uncomfortable effect produced in coast batteries at night, when messages are received that hostile parties have landed, while hostile ships are known to be in the neighborhood, knows how taxed are both the vigilance of the troops and the communications of the fortress. And, in war time, this tension will be increased a thousandfold.

It is unnecessary to labor this point, but as it is intended to discuss what influence conditions likely to prevail in war should have on training, it is essential to emphazise the fact that one must credit an enemy with every form of ingenuity. We must clear our minds of any tendency to regard him as an inanimate target moving on a beaten track.

It is not the object of the writer to plunge into the extremely controversial topic of the comparative value or uselessness of coast defenses. But it will be conceded by most officers, I think, that the term "Command of the Sea" may possibly in time of war imply something less definite than what it apparently now conveys to the man in the street. The extent of ocean, which may become the maneuver area of two or three great nations during a modern war, is so vast that the unexpected may often arise. Whether individually we favor the views of Lord Roberts, Admiral Mahan, Sir George Clarke, or others, we are faced with one conclusion. All nations, including our own, deem it expedient to fortify their principal ports, and contemplate the possibility of raids being carried out on their coasts.

It is extremely improbable, say some experts, that our coast defenses will ever be attacked, but what is still more certain is the fact that no serious attack will ever be made unless the details thereof have been thoroughly investigated. In this connection it must be borne in mind that nowadays the nature, extent, and armament of coast fortresses cannot be kept secret. There is little to prevent agents of a foreign power, especially in England, from ascertaining the sites and armaments of batteries, the contouring of the country, the approaches to the fortress, and the most minute details as to the suitability of neighboring mercantile harbors and inlets for the disembarkation of troops.

Thus, to choose an absolutely hypothetical instance, we will suppose that in the general plans of a campaign prepared in peace time in France, it was considered a strategic necessity that, naval conditions permitting, the port of San Francisco should be raided and a naval base there destroyed, in accordance with some French strategical plan. Then, it is surely obvious that the power of resistance of San Francisco, the topography of its surroundings, and other essential details would be investigated in peace time with minute accuracy.

The word "raid," somehow, conveys the idea of a slap dash and hasty attempt to inflict damage. One is apt to forget that it is futile and extravagant to attempt so perilous an undertaking unless very careful plans have been made. To render such an attempt excusable on strategic grounds, there should be reasonable hope in the minds of the attackers that the results, if successful, would materially affect the ultimate issue of hostilities.

We may apprehend a concentrated fire on certain batteries, the destruction of searchlights, magazines, etc., by landing parties, but such measures would or should form part of a larger scheme designed to secure the success of the main ulterior object. Taken singly, they would merely prove expensive means of producing minor irritation, and would serve no great purpose.

Let us now, bearing these points in mind, investigate the conditions under which our peace training is carried on.

First, as regards the more technical aspect of artillery training.

It will be readily admitted, even by the most critical expert in gunnery, that, so far as the study of ballistics is concerned, in the fine art of gunnery our training leaves little to be desired. The vagaries of every round fired from every gun are investigated, scrutinized, and tabulated with a care and a minuteness which knows no parallel in the services either ashore or afloat. Even the most conservative individual who regards himself as a practical man and distrusts all theoretical innovations, will admit that the greatest progress has been made during the last ten years as a result of the theoretical study of the various factors which affect gun practice.

The coast defense gunner, however, suffers from certain disadvantages which militate against realism, and from which other branches of artillery are comparatively free.

The most important of these are:—

1. He requires a moving target which, so far as is possible, should resemble a ship.

2. Such a target, unless it be merely represented by such "skeleton" devices as are now in use, is liable to severe damage and would also be exceedingly difficult to tow.

3. The fact that the target must be towed by a tug limits the course for reasons of safety, and also limits the extent to which converging fire can be brought to bear on it from batteries situated sone distance apart.

The natural result of these difficulties is that a hostile ship is now generally represented by two small frame-works of wood and canvas separated so as to represent the length, or a portion of the length of a ship, and so constructed that they can be towed at high speed by the engines of a tug.

The further results are as follows. A battery commander ranges on an imaginary line joining these two targets. From low sited batteries, especially, this ranging is a matter of extreme difficulty, but, alas! for the expert in this art, the difficulty is one which would never be met when firing at a real ship. A battery commander is said to be a good observer when he is able to judge quickly how far short or over this imaginary line his shots are falling, and whether he makes his corrections accordingly. He is eulogized or blamed in proportion to the degree of success he attains as a result of such observations and corrections. I am aware that there are a few who consider that with our present knowledge of gunnery, corrections would rarely have to be made. As, however, they are so frequently necessary in peace time, we must certainly expect them in war. A considerable amount of Q.F. ammunition is devoted annually to perfecting officers in this "observation of fire."

Now the difficulties which would present themselves in war are of a completely different nature. If an officer could identify his rounds when actually firing at a ship, he would have no difficulty in seeing if they were short. If over, they must be either clearly visible, or hidden by the ship. If they hit the ship, the battery commander might identify them, or he might find it difficult to distinguish their explosion from the flashes of the enemy's guns.

If other batteries were firing at the same ship, he would probably have no little difficulty in distinguishing his rounds from those fired from other batteries.

Again, the courses taken by enemy's ships would be very different from those necessarily adopted, for reasons of safety, by tugs towing targets. Ships would turn, alter their courses, pass one another, and thus cause further complications. Attempts are made, indeed, to make our present targets perform some evolutions, but their scope is extremely limited, as I have mentioned, for reasons of safety.

The fire commander and battery commander have little or no practice in peace time to teach them to cope with any of these difficulties.

Lastly, it must be remembered that should several ships engage land batteries, they would probably be prepared to expend a considerable amount of ammunition; the replenishment of this ammunition would furnish one of the problems for which due preparation would have been made. Now, there is undoubtedly a fixed idea, a strong belief inherent in the minds of many officers that the fire developed by ships against a battery on shore will necessarily prove very ineffective. This may or may not be the case, but it seems probable that if the fire of several ships were concentrated, even on a high sited battery, the number of shell and splinters which will fall in or near that battery will be considerable, even if the shooting be indifferent. Judging from the effect of artillery fire in the more recent wars, the result on the personnel of the batteries will not be negligible, and those who are not amply protected by cover will find themselves considerably harassed in the performance of their duties. I think this factor has not been sufficiently considered in furnishing cover for officers and others. Old concrete or stone works on which modern guns are sometimes mounted might verily become death traps under even a moderate fire.

Ignoring the elementary work carried out by companies, we may consider gun practice under two headings, Service Company Practice and Battle Practice.

I suppose there is no subject more widely and hotly discussed than that of the advisability of retaining Service Company Practice. If we disregard the extremists on both sides, however, we find that most officers are emphatic on two points, namely:—

1. That some form of competition, or at least, some form of classification, is necessary, in order to stimulate interest in all ranks, but especially amongst the gun members.

2. That, in any practice, where the object is the attainment of a certain standard, or where there is competition with other units, other considerations will be sacrificed for these ends. Unrealities will creep in, and that fickle, but probably necessary fetish, the "Figure of Merit" will swell in importance.

Reçognizing these human frailties, the authorities at first drew a line between Service Company Practice and Battle Practice, and it was hoped that by confining the standardization to the former, the latter would become more realistic than would otherwise be the case. It was then pointed out, however, that a unit might score heavily in the Service Company Practice, and then carry out Battle Practice with the most indifferent results. Its Figure of Merit, however, was not influenced thereby, and the system was warmly condemned by numerous critics. To remedy this it was decided to give marks for efficiency in Battle Practice. Unfortunately, here again, human nature asserted itself. The result has undoubtedly been that Battle Practice is looked upon largely as a means of increasing the Figure of Merit, much to its detriment as a practical test of the efficiency of the fortress.

I may mention, perhaps, that the Siege Artillery has undoubtedly been confronted with similar problems; probably officers of the Horse, Field, and Mountain Artillery would tell the same story.

It should be remembered that, however carefully the system is prepared under which a Figure of Merit is calculated, the results probably do not represent the comparative efficiency of the units with any great degree of accuracy. Take, for instance, the effect of weather. One company may carry out its series in clear, calm, weather. Another may practice in a strong gale, with a target rising and falling in a heavy sea, or the light may render observation most difficult. Yet this most important factor is quite ignored in the standardization. It would be interesting to know, indeed, whether the superior results obtained at practice, and, I think, at musketry in 1911, were not in some degree due to the abnormally fine summer.

Now to what extent can we further the cause of realism in our practice without interfering with the sporting competition which is generally considered necessary as a stimulant?

Attempts are made every year to mobilize a fortress for several days. Of course the absence of the reservists, who cannot be called up, renders such mobilization incomplete. Still, so far as the artillery in concerned, the annual mobilization should form a useful test of the state of the defenses. Hitherto, a certain amount of Battle Practice has generally taken place during these periods, and the results now affect the Figure of Merit. Consequently the fetish appears again. Every round, the gun elevation, mistakes in giving ditto, time of every gun, etc., etc., are all recorded in voluminous practice reports, and the collection of the statistics necessitates the attendance of an army of umpires and recorders in each work. If several batteries are firing simultaneously the difficulty of obtaining all these records is considerably enhanced. Consequently it has been found, sometimes, impracticable to carry out Battle Practice at all during the mobilization, there not being sufficient staff to collect data, without withdrawing many individuals from their posts.

Surely, if units have carried out Elementary Practice, Service Company Practice, and some Battle Practice, they might be permitted to carry out some Fortress Battle Practice during mobilization without elaborate records and Figures of Merit.

A record, of course, is necessary, but only of the most essential
It should be considered that the units are receiving training in th
in the defense of the fortress. To enable this to be done, the
batteries need receive is that half charges or full charges wo
certain days. This is essential, as it is not a service limita
of this precaution might involve a meaningless delay,
course be fixed to the number of rounds to be fired.

The great difficulty arises in regard to targets. The tugs, several of them, would proceed to sea overnight, and the principal range officer should have to some extent a free hand in attacking. This delegation of responsibility allows a range officer to refrain from approaching the port until he thinks the range is reasonably clear.

I would also venture to suggest that when it is desired that several batteries should engage targets representing a number of ships, it is not essential that all these targets should be towed. A number of them might be drifting, thus allowing a considerable increase in the practice area on all sides. This proposition may sound retrograde in character, but it should be remembered that all previous practice will have been carried out at towed targets, and, if it be considered advisable to sacrifice this speed of targets occasionally, in order that experience may be gained in other directions, we should not hesitate to do so.

The writer is aware that a serious argument will be urged against combined Battle Practice carried out at numerous targets as I have suggested, and this is, that the rounds fired from individual batteries will be hard to identify, and that the scanty practice reports proposed would make this still more difficult. A few assistant umpires in the batteries and on the tugs, however, should be able to keep a very fair record of the practice, and the diagnosis of the symptoms evinced by individual guns is not, it should be borne in mind, the main object of this practice.

Now, as regards marks. Strictly speaking, if such are necessary during any Battle Practice, they should be allotted to Fortresses, Sections, or Fire Commands, not to units. Probably it would be more instructive if merely a report were compiled by the Chief Umpire, and its contents digested at a pow-wow.

During a part of the Battle Practice, experimental departures might be allowed within reasonable limits. For instance, it is a question for consideration whether our present system, under which a battery commander observes and corrects the fire of two or three guns, is a sound one. Far be it from me to assert the contrary, but, after watching a number of series it has often occurred to me that in many respects a system under which an Officer or N.C.O. would observe and correct the fire of each gun, would be preferable. This may be regarded as rank heresy, and it will be urged that guns of a group should not shoot differently. In considering a point like this, however, we must not think of guns being manned by a Utopian Regiment of Artillery, but by human, though excellent, gunners, whose weaknesses, common to all mortals, will not be less in war than they are in peace. Is it not possible that there is a trace, a small trace, doubtless, of the survival of old field artillery methods extant in our chain of command and in our ranging? On the other hand, such a surmise may be entirely faulty. Experiments would show.

Had we unlimited means, we should all like occasionally to practice at some old hulk with live shell, and thus gain some personal knowlegde of ranging and distribution of fire at a ship, but this appears to be impossible for financial reasons. If such practice were possible we should be able to judge whether it would not be profitable to send our first rounds short of the target, afterwards increasing the range, even at the risk of being branded with the heinous crime of "creeping."

To revert now to the principles of co-operation.

As regards the Royal Navy, we are indebted to them for the assistance they render us in deputing torpedo craft to attack our channels. But there is a larger side to the question. Our navy, on the outbreak of war, is doubtless to be an aggressive navy. Our ships will not remain sheltered in our harbors, but will seek out the enemy's ships. In all probability the enemy, weaker afloat than Great Britain, will make much use of defended ports. Without suggesting that our ships should hurl themselves headlong at such fortified ports, is it not likely that raids on such places will be necessary? And would it not be of advantage to all concerned if our navy were to maneuver more often against our own ports? It would be most instructive for us, if, during our few days' mobilization, a small fleet were deputed to carry out a raid, or some such operation. Such maneuvers would entail the presence in the fortress of the infantry told off to defend it. The infantry, doubtless, could not all be there, but there should be little difficulty in assembling a proportion of the war garrison for a few days. There should be a plentiful supply of blank ammunition to be fired from the smaller guns, and from the sub-caliber guns to represent the fire of their parent weapons. Blank ammunition is necessary, as without it there are always heated arguments as to whether a battery opened fire at a certain time or not.

I would even go so far as to urge that the navy should tow targets for us during those few days, though I tremble as I make the suggestion, for I cannot imagine such a proposal being received by naval officers with equanimity.

The navy, again, could render us incalculable assistance in clearing the range, or as substitutes for picket boats at night practice. As it is, we hire tugs at a considerable cost, place them under the supervision of sea sick and forlorn subalterns, and hope for the best.

A few years ago I had the pleasure of seeing the navy clear a range and tow a target for some experimental practice. The work was most efficiently and expeditiously done. It was indeed refreshing to see the vast saving of time effected, and to notice the absence of that lethargic appearance that usually pervades the personnel of a battery and spectators, when they have been waiting some six hours or so for a clear range.

From the national point of view there is much to be said for such cooperation. To arrange it must be difficult, the two services being under different administrations from top to bottom. It is clear, too that the navy must be considered first, but surely more might be done for the common end without unduly interfering with the training of either service.

In the forgoing pages I may have emphasized points which will be regarded by many as platitudes of a time worn type. On the other hand some of the suggestions may be regarded as almost fantastic. My object, however, has been to urge the importance of carrying out the final stages of our yearly training on broad lines, with the assistance, if possible, of both the Royal Navy and other branches of the Army.

—*Journal of the Royal Artillery*, April, 1912.

◆ ◆ ◆

AUTOMATIC SUBMARINE MINES*

(Concluded)

APPARATUS FOR LAYING AND MOORING MINES

Of equal importance is the design of suitable mechanism for launching or laying and mooring the mines in waterways, and Messrs. Vickers,

---

* Continued from Journal U. S. Artillery, July-August, 1912.

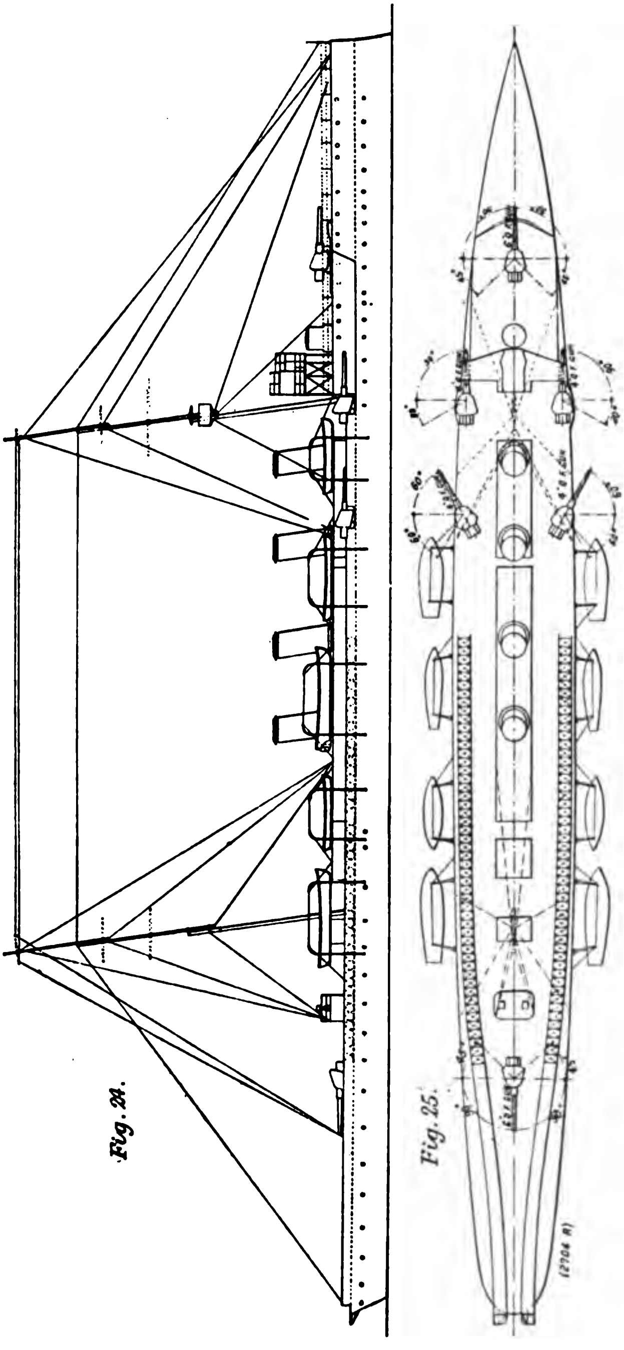
Limited, and Captain Elia have devoted much experimental research to the devising of satisfactory mechanism. Tests have been made with four different apparatus:—(1) With the rolling of the mine along the deck and tipping it over the stern without any appliance; (2) with a tilting-tray projecting from the stern; (3) with the application of pivoted levers used as tongs for supporting the two sides of the mine, while the lever or tongs move from the vertical through about 90 degrees until the mine drops from the end of the tongs of its own accord by reason of their inclination from the horizontal—a method which secures the placing of the mine in the water smoothly; and (4) the substitution for the tongs of a projecting carriage with rails from the stern, whereby the mine is dropped into the water.

As a prelude to the detailed description of these methods, there is given on page 234 (Figs. 24 and 25) an elevation and plan of a mine-laying ship fitted with machinery to attain a high speed. There are, as will be seen, bow and stern chasing 6-inch quick-firing guns, while forward on each broadside there are two 4-inch quick-firing guns. Lines of rail are laid along the deck on each side, connecting with two sets of launching gear aft. This gear may be of any of the types which we have already enumerated.

The simple system of tipping mines from the deck was adopted in the Italian Navy in 1888. The mine, with its anchoring-chamber, formed practically a barrel, and was rolled without rails along the deck and over the stern. Once in the water, the mine took a vertical position owing to the heavier weight of the anchoring-chamber. The plumb of the sounding-line at once began to sink, followed by the anchoring-chamber, as has been described in our previous article.

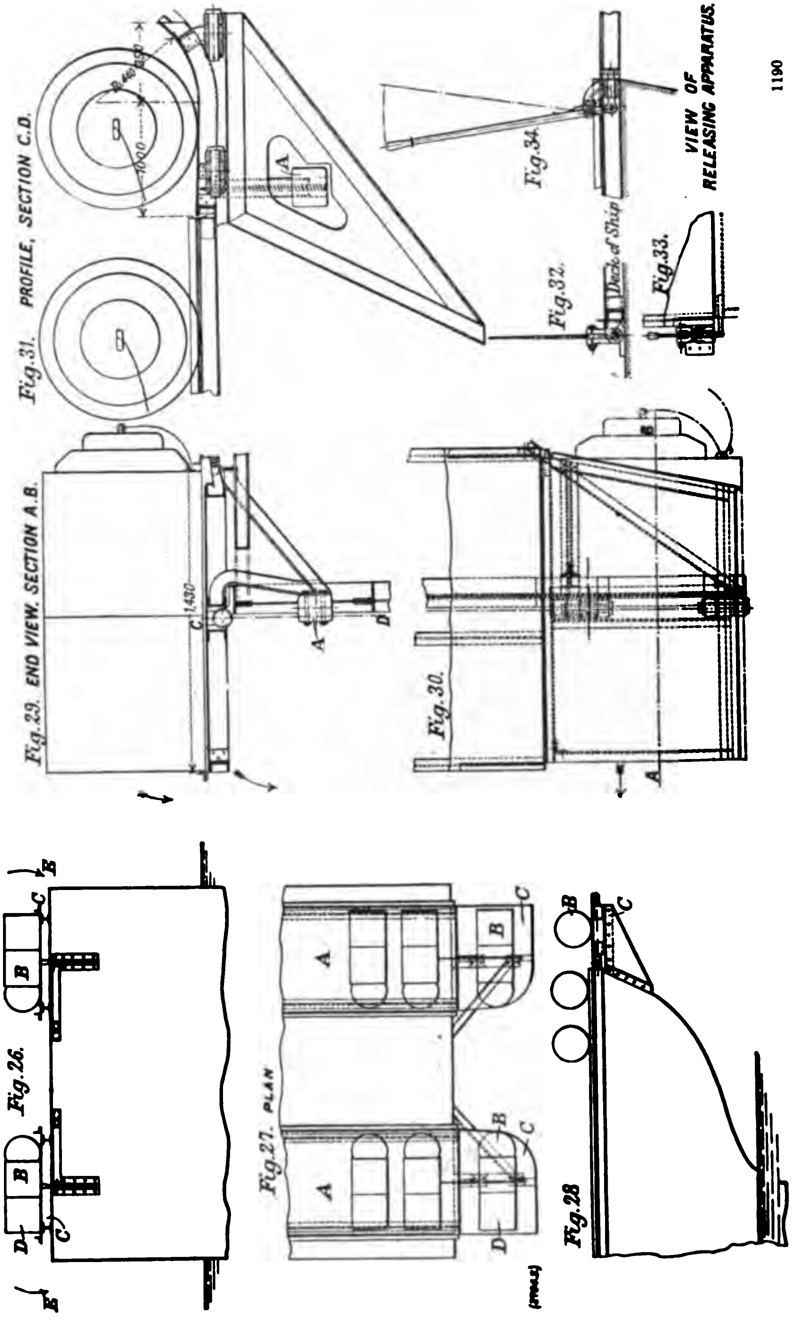
The next development in launching gear was tested at Toulon, and is illustrated by Figs. 26 to 37, on pages 235 and 236. In this case the mines are rolled along the deck, finally entering upon a path of steel plating, supported on H joists with angles along the sides. The path terminates on a tilting-tray projecting beyond the structure of the ship, as shown generally in Figs. 26 to 28. A is the path, B the mine, D the anchoring end, while C is the tilting-tray, the arrow E showing the direction of movement of the mine from the tray. The tilting-tray is illustrated in detail by Figs. 29 to 31. It is constructed of channel irons, those supporting the steel platform plate being curved at the outer extremity to prevent the mine from rolling off. The tray is mounted on a shaft carried on a suitable bearing projecting beyond the deck, and on this shaft the tray can tilt from the horizontal to the vertical plane, the greater weight of the anchoring end of the mine sufficing to effect the tilting motion. The end of the tray, which moves downwards, is normally held in place by a locking-pin, which enters a strongly formed recess on the tilting-tray, as shown in Figs. 32 to 34. This pin is withdrawn from the recess by an ordinary locking-lever, as shown. Under the tray there is formed a supporting triangular arm, in which fits a counterbalance weight, so that immediately the mine leaves the tray the latter is brought back into a horizontal position, the locking-pin being thrown back into the recess in order to lock the tray in this position.

The engravings (Figs. 35 to 37) show the trials of this tray when fitted to a barge at Toulon. The first view shows the mine being rolled on to the tray; the second, the tray ready to be released by the removal of the locking-bolt. The photograph reproduced in Fig. 37 was taken as the mine entered the water, the tray, after the mine has been dropped, returning to the horizontal position and being locked in place. With two such apparatus mounted



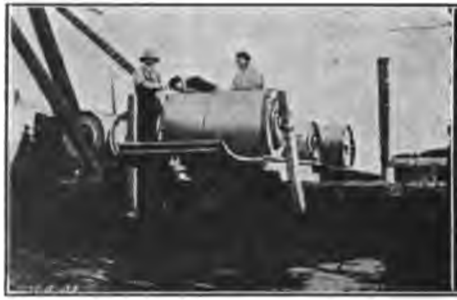
Figs. 24 and 25.
Mine-laying ship

Engineering.



Engineering.

FIGS. 26 TO 34.



Engineering

FIG. 35.

Rolling the mine on the tray

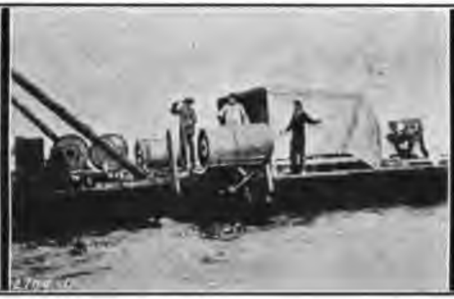
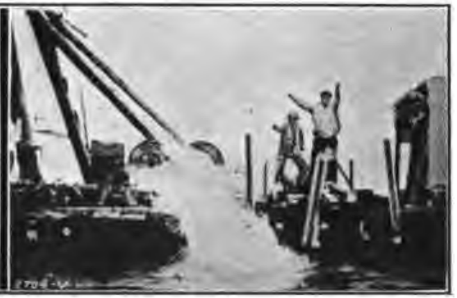


FIG. 36.

Unlocking the tray



1191

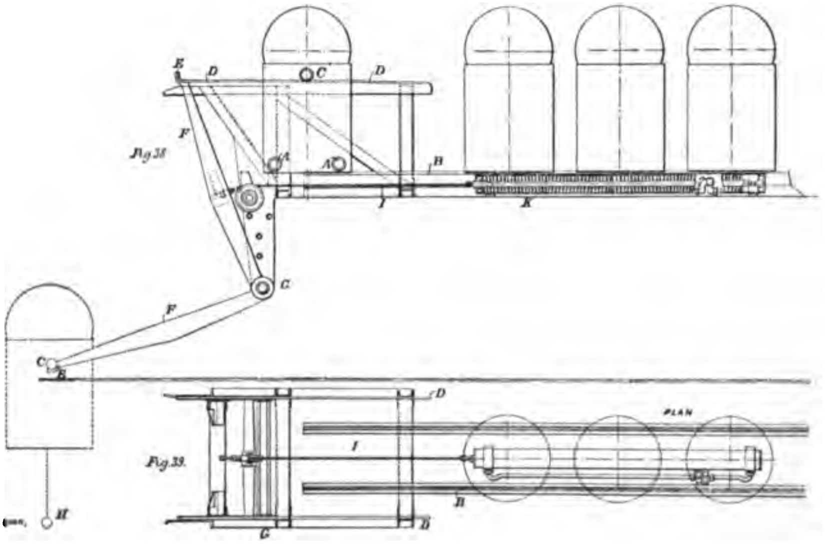
FIG. 37.

The mine dropped

on a vessel steaming 15 knots it was found possible to lay the mines from two tilting-trays at intervals to make them effective against vessels of ordinary beam. If mine-laying, however, were required to be done at a speed of 30 knots, four such tipping-trays would be required.

In laying mines by the two methods we have just described, a certain degree of shock was involved when the mine came in contact with the water, as is suggested by the view in Fig. 37, and it was always possible that some breakage might occur, particularly in the case of any parts which projected beyond the main line of the structure of the mine. Little damage could be done to the mine itself, nor could there be any chance of premature explosion, although the sensitiveness of the detonator might, under certain conditions, be susceptible to effects from such shock. A method was therefore devised of placing the mine smoothly on the surface of the water, so that it would be in a position to sink gently by the gravity of the anchoring-chamber, with the sounding-line in advance of it. The apparatus designed with this end in view is illustrated by Figs. 38 and 39, on page 238. The mine is moved to the stern of the ship in its vertical position, the anchoring-chamber, of course, being at the bottom. This is done on rails which terminate between two uprights. For transit four wheels are provided at the corners of the anchoring-chamber, marked A on Fig. 38; these run on rails B. Near the top there is secured on each side of the anchoring-chamber a wheel C, and as the mine advances near to the stern these wheels come into contact with the rail D on the uprights, which project beyond the stern of the ship. By means of these rails the mine is run on to the upper ends E of two levers F pivoted at their bottom ends G to a strong frame forming part of the structure projecting beyond the stern of the ship. The upper ends of the levers overlap the projecting upper rail, as shown on the plan, Fig. 39, and are braced together at mid-distance, while at the bottom the pin G forms a connecting stay. As soon as the mine reaches the curved lodgment at the top of these tilting levers, its weight causes the levers to tilt on the center G through 90 degrees. To prevent too rapid motion there is connected to the center stay between the levers a cable I, which, passing over a pulley, is connected to the piston of an hydraulic buffer having a connection between both ends controlled by valves. The buffer offers sufficient resistance to make the movement of the lever to the surface of the water gradual and gentle. A spring, as will be seen, is combined with the hydraulic cylinder, so that its compression is utilized to draw the lever tongs by the medium of the same wire rope back to the vertical position ready for receiving another mine. This combination of spring and cylinder follows generally the lines which have proved so satisfactory in taking up the recoil of guns and subsequently running them out again to the firing position. By adjustment of the valves, and the length of rope connecting the piston to the tongs, the angle of the tongs in the bottom position can be varied, so that, irrespective of the freeboard of the ship, the mine will leave the end of the tongs at the surface, as shown in Fig. 38. It will be seen that the weight of the sounding-line H is sinking in advance of the anchoring-chamber.

Trials made with this system proved very satisfactory. The time taken for the lever tongs to descend through the 90 degrees was two seconds, and to return to receive another mine one second, so that the mines could be laid in the water quietly at intervals of a little over three seconds. All vibration and shock are practically obviated, and the fitting of the system to the stern structure of any ship is a simple matter.

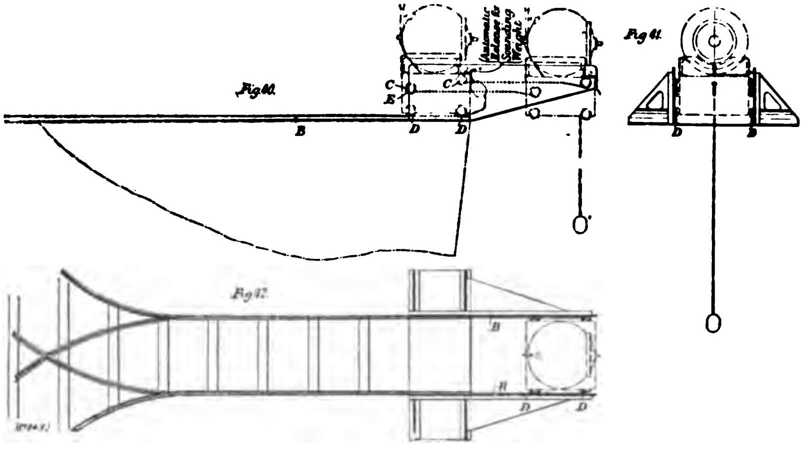


Engineering.

FIGS. 38 AND 39.

1192

Lever tongs for laying mines on the surface



Engineering.

FIGS. 40 TO 42.

1193

Latest system of dropping mines vertically from rail carriages

Fuller experience, however, showed that no danger need arise from shock in dropping the mines from the level of the deck of a ship, particularly with the type of mine having a radial lever for controlling the charging gear—a system which we have described as the design 5A (Fig. 10, opposite page 74, JOURNAL for July-August 1912). Here everything is so securely locked, until a ship comes in contact with the lever and causes it to rotate angularly on its pivot, that it was felt that the dropping of the mines could not cause any premature explosion, or damage to the structure when well made. It was therefore decided to revert to this arrangement of dropping the mines over the stern of the ship, because of its great simplicity. The system ultimately devised is illustrated by Figs. 40 to 42.

The mine, with its anchoring-chamber and sounding-line weight, is moved sternwards on wheels A, travelling on rails B. There are, however, two upper wheels, marked C C, at different levels on each side, and these wheels come in contact with the rails at corresponding levels. The aim in having rails at different levels was to enable all four upper wheels to disengage simultaneously from the rails at the end of the travel on the structure projecting beyond the ship, so that the mine could have no tilting movement when dropped overboard. This will easily be grasped by references to Figs. 40 and 41. It will be noticed that at their ends the rails have a slight decline towards the water-line, so that the mine drops easily.

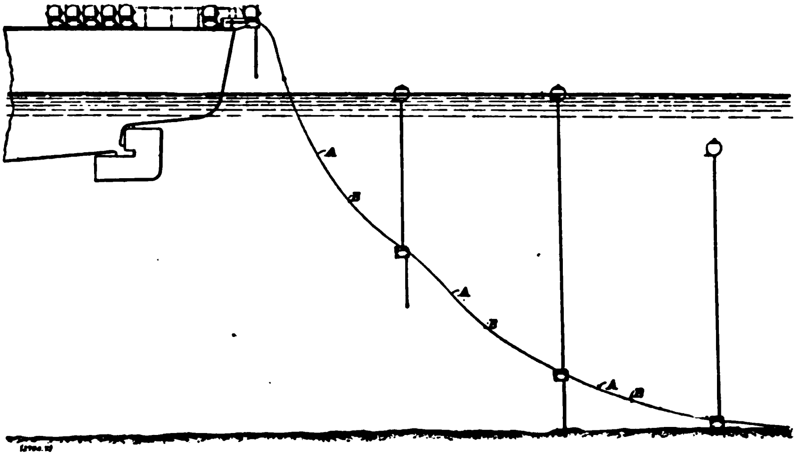


Fig. 43.
Picking up mines

As will be seen from Fig. 40, there is a projection on one of the upper rails which releases the weight of the sounding-line, so that it drops from the anchoring-chamber and is extended to its fullest length before the mine leaves the upper rails.

Since the trials of this gear, which proved thoroughly satisfactory, a modification has been made, as it was found possible to dispense with the intermediate wheels E, utilizing the rear lower wheels and the upper wheels C, for traversing the mine along the launching-frame.

Captain Elia, in the course of his research, has given consideration also to the best method for rapidly picking up mines from a mine-strewn field. Earlier in his research he determined that the most effective method was to connect the anchoring-chamber of each mine when it was launched to a general connecting cable, so that through this connecting cable the mines could easily be recovered.

To the end of the cable first dropped into the water an anchor is secured, and the cable is connected to the anchoring-chamber of each mine by an eye-bolt fitted to the anchoring-chamber for this purpose. On the cable at distances corresponding to the pitch of the mines, there are stops too large to pass through the eye-bolt on the anchoring-chamber, so that as the cable is hauled on to the mine-recovering ship by means of a winch or capstan, the anchoring-chambers of the mines are successively dragged towards the ship, and by this means are raised on deck, the flotation chamber following the anchor-chamber. Fig. 43 illlustrates this arrangement. Care, of course, is taken to obviate any possibility of the contact lever releasing the firing apparatus.

The general conclusion, which results from a careful consideration of the designs, and of the exhaustive trials which have taken place, is to establish the superiority of the spherical mine with a contact lever attached to the bottom of the mine. This design is known as No. 5A, and is illustrated by Fig. 10, opposite page 74, JOURNAL for July-August, 1912.

As regards the launching gear, the system which has proved the most satisfactory is that illustrated by Figs. 40 to 42, on page 238, and already fully described.

The record of Captain Elia's work, apart altogether from the conclusions which emerge from consideration of the subject, shows great mechanical ingenuity, and affords a guarantee of the successful character of the design. The wide experience of Messrs. Vickers, Limited, further gives confidence in the view that the details of the design will be carried out, in respect of materials used and of precision in manufacture, in a way to obviate any possible accident through fracture or faulty workmanship.

—*Engineering*, May 3, 1912.

◆ ◆ ◆

THE ATTACK OF A COAST FORTRESS

By Lieut. GOLIASCH, Austrian Artillery

Translated from the *Artilleristische Monatshefte* for March, 1912, by Lieut. A. C. B. NEATE, R. G. A.

The attack on a well defended sea front provided with modern and adequate equipment is one of the most arduous tasks that a fleet can be called upon to undertake. The fact that only a fleet of very superior gun power will have any chance of success against well-sited shore batteries will largely deter naval commanders from fighting their ships under a considerable disadvantage, and so risking very costly material in an undertaking, which even if successful is only of secondary strategic importance. Whether the gain resulting from such a successful attack is commensurate with the probable loss of life and material involved is a question on which there is a great diversity of opinion.

In the case of the battle of Lissa, which might be cited as a successful attack of a fortress from the sea, one must remember the vast superiority of the Italian fleet to the armament of the island, both as regards the number and value of guns. The island mounted 88 guns, of which 31 only were rifled, against 645 in the fleet, of which 319 were rifled, and yet the gallant gunners of Lissa, by their stubborn resistance, materially affected the course of the war, and in fact paved the way for Tegethoff's subsequent victory.

RECONNAISSANCE

The reconnaissance of an enemy's position falls under two heads—viz.: that which is carried out in peace time and elicits all there is to be known about the permanent works, and secondly, the actual reconnaissance carried out by a commander, of the target he is going to engage. The first of these should place at the disposal of any admiral all the information he wants as to the positions of permanent works, etc.

Against a low flat coast line, all that should be left for the admiral to find out, over and above the information supplied by his own intelligence department from facts collected during peace time, is the actual appearance of the batteries, works, etc., so that he may be able to easily recognize them under all conditions of weather and light, and be able to fire at them, even by night with some hope of success. This is assuming the defenses will be more or less cunningly masked, as will usually be the case, so the mere height above the sea level is not the only obstacle in the way of a reconnaissance of the defenses from the sea.

NIGHT ATTACKS

Night attacks will be mainly carried out by torpedo boats, but in their most important duty, namely, forcing an entrance to a harbor, the latter will require the cooperation of battleships, or at any rate, cruisers. In such cases the larger ships will be employed either to protect the torpedo boats, or in making feint attacks on other parts of the coast.

AIR-CRAFT

Nowadays the reconnaissance of coast fortresses will be carried out principally by air ships, which will supplement and confirm the information collected in peace—this is a particularly arduous and dangerous task, and necessitates a very high standard of peace training of aviators. The fire of the defenders will necessitate the air-craft being kept continuously in rapid motion, while to make any sort of survey of the fortress or even to correct existing plans must require very deliberate observation—and a combination of these two will require a very high technical training of aviators.

Supposing, however, a reliable plan of the fortress to have been executed—from aerial survey or otherwise, of what assistance will it be to the attackers in the bombardment? Surely very little! For the position of the land works is of no consequence as far as the navigation is concerned—and such a thing as indirect fire from ships against forts is scarcely to be thought of, for even in the rare case of a ship being able to take cover behind an island or spit of land, it is very doubtful if the flat trajectory guns could clear any cover, except from positions in which the defenders would be able to see them.

The remaining duty of the reconnaissance which we have not yet considered, is obtaining information about the actual armament, and it is only on the heavy and medium guns that it will be required, since the light anti-torpedo-boat guns show themselves at the first opportunity, and, further, play no important part in the contest of fleet and fort.

The heavy guns, from their very nature, can only be mounted in peace time, and even those of medium caliber would be in position on or before the outbreak of hostilities.

A rough survey of the armament should, therefore, determine the number of guns, and whether they are heavy or medium, but any further detail, such as reporting of exactly what caliber a particular gun was, or discriminating between, say a 6-inch and a 7.5-inch would probably not be possible. The difficulty of taking stock of a gun from above is considerably enhanced by the shield with which most modern coast defense guns are provided—future gun emplacements will be provided, too, with special concealment from fliers.

ANTI-AIR-CRAFT GUNS

Up to the present the repulse of balloons and air-craft generally has never been taken very seriously, but now either a special anti-balloon gun, or an ordinary gun adapted for shooting skywards, will be indispensable in any fort, and this will not improve the chances of the air scout.

It is almost obvious then, that information on all essential points concerning any coast line to be attacked should be available for the commander of the attacking squadron, as the result of intelligence work done in peace time.

Collecting such information at, or after, the outbreak of hostilities is clearly belated.

The only thing which should remain for airships to do in this respect is to confirm and amend existing plans, fill in minor details, and add any makeshift works, etc., improvised by the defense in the last few weeks or even days preceding the outbreak of war. They should also, of course, be able to render valuable information as to movements of troops, and the position of mobile batteries, reserves, etc.

From this it would appear that the spy plays a more important part in the reconnaissance of a coast fortress than the scout, and surely the former can, and will do much the most work in this direction, more particularly as coast forts must be at all times in a state of readiness, as an attack on them always takes place in the opening stages of a campaign. The appearance of hostile ships may even be expected within a few hours of the breaking off of political negotiations.

THE ATTACK

In the actual attack, if the ships are steaming in line across the front of the fort, they present to the guns a target of at least 18′×360′ in area—and with the flat trajectory of modern guns the projectile strikes the armor at an angle of very nearly 90°, which is not only the most favorable for the shell to penetrate, but also offers the shortest way through, since this varies inversely as the sine of the angle of incidence. The more the line of fire deviates from the normal to the ship's side, so much the more is the coast gun at a disadvantage. The least favorable condition being when the target is sailing end-on to the fort, when the only thing left for the guns is to try and injure superstructure, turrets, etc. These are of course well worth destroying, but are much less vulnerable, partly from their being very thickly armored, 12-inch and upwards, and partly from their surface presenting a very unfavorable angle for the projectile to strike.

HIGH-ANGLE FIRE

High-angle guns are eminently suited for engaging such targets, as the ship presents a horizontal surface of not less than 360 feet in length and 75 in breadth. Since the 50% zone for such guns at effective ranges can be taken as about 130 feet, and the breadth zone 30 to 36 feet, the advantage of this nature of fire is apparent.

In order to make the conditions as unfavorable as possible for the forts, whatever type of gun is employed, the ships should, *theoretically*, steer a course inclined at 45° to the line of fire of the guns.

It is evident, therefore, that a ship is placed at a great disadvantage, if, even for a moment she presents her broadside to the guns of a fort, and therefore she will, with a view to developing her own fire and placing that of the defense at a disadvantage, steer a course inclined at 45° to 55° to the front of the fortress. The angle should not exceed 55°, for it has been found by experiments (carried out by the Bethlehem Steel Co.) that at angles of incidences up to about 35, the shell, even if capped, ricochet off without doing any harm.

COURSE

Another consideration of some importance is whether a ship should steer a straight or curved course.

In following the course of any target with a view to predicting its position at a given moment, battery commanders resolve the ship's actual course into two components, one in, and the other perpendicular to the line of fire of their guns, and determine the change of position along these two lines in a given unit of time, say 30″, or the time of flight of their shell, and on this they base their range and deflection. These components should be determined as soon as the ship gets within range. If the ships were to steer on a circular course, the center of which was the battery, these components would remain constant, and the work of the battery commander would be, in this respect, very much simplified. In any other case, however, these components are not constant—if a straight course is steered they alter gradually and regularly, and in a very much curved course they change rapidly and irregularly, so much so as to necessitate a correction every second or third round. From this it would appear that an irregular serpentine course has after all a good deal to recommend it. The position of the turrets on board the particular ship must also to a certain extent determine the course, so that the maximum number of guns can be brought to bear at the same time. Taking everything into consideration, the most favorable course from the point of view of the ship, is a very flat ellipse with its longer axis inclined at 45° to the coast, for this enables the greater number of guns to be brought to bear, and offers a difficult target both for guns and howitzers.

Steaming at high speed still further reduces the chance of a ship being hit by a howitzer, as it is impossible for the battery commander to predict with any accuracy the position of a rapidly moving ship [at the end of] the time of flight, which in a high-angle gun is of course considerable.

CONCLUSION

From all that history and literature teach us about coast warfare, there is one thing remains fairly clear, and that is that any naval commander will think very seriously about attacking a coast fortress from the sea. Santiago de Cuba, and more recently Port Arthur, are instances of this—in neither case was a vigorous bombardment carried out by the fleet. Although the Japanese may have been justified, considering the superior armament of the forts, in reserving their fleet for more profitable work on the high seas—the conditions before Cuba were most favorable to the Americans, and a vigorous offensive seemed clearly indicated.

Although the Spanish garrison was very inadequate, and the guns both in numbers and quality far inferior to those of the enemy, yet they were able to keep the powerful American fleet at a distance, much as the defenders of Lissa had done thirty years previously. This all tends to confirm the opinion held by many, that coast fortresses are best attacked from the land side, and in such warfareonly the secondary duty of keeping the defenders to the sea front, and of blocking the harbors will fall to the share of the fleet.

—*Journal oi the Royal Artillery*, July, 1912.

Short Notes

Zeppelin Military Airships.—The new Zeppelin military airships, according to reliable information, are provided with platforms under the ship for two guns, and a platform on top for a gun and observation purposes. The top platform is reached by a middle passage from the gondel and affords space for the gun, instruments and two or three men. The gun is of such caliber as to use shells. The experiments are successful. This fact, in connection with the use of wireless, already established, and searchlights on airships marks an important step in the development of aircraft and brings into consideration anew the importance of the large airships.

French Gunpowder.—The loss of the *Liberte* has had the effect of breaking down the Government monopoly of the manufacture of powder in France. Hitherto the "Poudre B," which has been the cause of so many grave accidents, has been manufactured exclusively in the Government factories, and its quality is so bad that the French ships have had to land the whole of their powder, and are at present unable to carry out even their ordinary target practice. In deference to popular clamor, the Monopoly Law has at last been repealed, and it is intended to divide the orders among the private factories, which, it is anticipated, will at once be set up. In the meantime, the Ordnance Department are experimenting with ammonia powder. This is an excellent and safe propellant, and its only disadvantage is that it is hygroscopic, and has to be kept under a metallic seal. Last year the French Government invited foreign tenders for the supply of powder suitable for naval and military purposes, but German makers were barred, and we have not heard of any application from British sources.

—*Army and Navy Gazette*, July 27, 1912.

Experiments With Explosives.—The Commission which was appointed to inquire into the causes of the explosions on board the *Jules Michelet* has presented a report that is anything but reassuring, and can, indeed, only be regarded as a condemnation of the nitro-cellulose explosive as at present manufactured in France. The conclusions of the report are to the effect that the accidents were not due to any deterioration of the explosive or to any inflammation resulting from the high temperature of the gun. Consequently, the inquiry must deal principally with the composition of the explosive itself, notably as regards the gaseous emanations which may prove highly dangerous under certain conditions. Until recently there has been a reluctance to attribute the many disasters to the want of stability of the B explosive until all the other possible causes had been investigated, but in view of the recommendation of the Commission it is evident that the naval authorities at length admit the probability of this lack of stability, and declare the explosive to be much too dangerous to be used on board ship. The Minister of Marine has, in fact, suspended all practice firing until the experiments now being carried out shall have been completed. Not only are careful and rigorous tests being made with the nitro-cellulose explosive, but the Marine has recently purchased quantities of nitro-glycerine explosives abroad with a view of making comparative trials. The seriousness of the situation is fully recognized in France, where nothing is being left undone to provide a solution as rapidly as possible. Meanwhile, it is complained that these troubles, which might have disastrous consequences, are the direct outcome of the monopoly system. As the explosives are manufactured solely by the State, everything is left in the hands of comparatively few engineers, who, however eminent they may be, are not always suitable for the positions they occupy, and the recent removal of two well-known engineers shows that there is sometimes a lack of harmony in the service and a want of proper supervision. It is pointed out that, by suppressing the monopoly and permitting the manufacture of explosives by private firms, there would not only be more encouragement to carry out research work but that a larger body of experienced engineers would be available for drawing upon by the State factories.—*The Engineer*, August 2, 1912.

Triple Gun Turret Test.—Very little information, and that little of a very indefinite sort, is obtainable at the Navy Department concerning the test of the new type of triple-gun turrets intended for installation on the *Nevada* and *Oklahoma.* Some time ago after the plans of the battleships had been improved, including the assemblage of the guns in the main battery, the bureau of ordnance represented to the department the disadvantages likely to accrue from placing three guns in one turret and expressed a preference for the two-gun arrangement. Secretary Meyer did not regard the objections as sufficient to justify a radical change in the plans for the battery of the vessels and ordered that the bureau proceed with a modification of the turret design so as to provide for the triple-gun distribution as was originally intended. This has caused something of a delay. The mounts were to be finished in time for the trial on the 1st of April. The delay may have serious effect on the completion of the vessels, especially as there are indications that the triple-gun turret will have to be modified in some particulars. While nothing has been vouchsafed by the naval authorities as to the results of the test at the Indian Head proving ground, it is intimated that the trials were not entirely satisfactory in all respects. The extent of the necessity of improvement is not, however, made known. In any event, it looks now as if there would be further delay in the completion of the turrets. It remains to be determined whether this triple gun arrangement will be extended to the next battleship designs. Some consideration is being given to the proposition of a return to the two-gun turret, with an increase in caliber from 14 to

16 inches in the gun, and by that means adding to the power of the ship. Should the 16-inch gun be adopted an effort will be made to have as many as ten guns of that caliber on a battleship, although under existing conditions it is doubtful if more than eight 16-inch guns could be accommodated without too great a demand upon the weights required for the other chief characteristics.—*Army and Navy Register*, July 27, 1912.

New Battleship Designs.—The ship * * of the battleship class to be built in accordance with the * * naval appropriation bill probably will represent important advances in several details over the *Nevada* and *Oklahoma*, the last battleships to be laid down. The Senate amendment provides that the vessels shall each cost not to exceed $7,425,000, exclusive of armor and armament. This sum will be sufficient to build a ship of a displacement of 30,000 tons, or 500 tons heavier than the *Nevada* and *Oklahoma*, and undoubtedly the vessels will be designed for this size. The suggestion has been made that 16-inch guns be installed on these ships, but the view prevails among the ordnance experts that the time has not arrived to advance beyond the 14-inch guns, such as will be installed on the *New York* and *Texas* and *Nevada* and *Oklahoma*, each of which will have ten such guns. However, with the 500 tons increase in displacement, it may be found possible to install twelve 14-inch guns on the new ships. The arrangement of the guns is another problem to which the experts are giving much attention. The *New York* and *Texas* will have their ten 14-inch guns arranged in five two-gun turrets, and the *Nevada* and *Oklahoma* will have four of them in two two-gun turrets and six in two three-gun turrets. The three-gun turret, so far as our Navy is concerned, is an innovation. A turret of this kind has been erected at the naval proving ground at Indian Head, Md., and some tests have been made with it. Further tests are to be carried out, but the ordnance experts are reticent in regard to the developments so far made. The conservative naval view is toward the two-gun turret; and, if twelve 14-inch guns are installed on the new ships, they probably will be arranged in two-gun turrets somewhat after the center line arrangement of the twelve 12-inch guns of the *Arkansas* and *Wyoming*, about to go into commission, which have two turrets forward of the central super-structure, and four aft. Other tests are under way or in contemplation that may have some effect on the details of the new ships, among them firings at a cage mast, tests of several forms of marine propulsion, etc. A cage mast is being erected on the hulk of the *San Marcos* in Chesapeake Bay, at which shots will be fired within a few weeks, and it is expected that there will be a settlement of the question as to whether this form of mast shall be retained on present ships and placed on new ships. The *Nevada* and *Oklahoma* will depend entirely on oil fuel for their boilers, and the naval engineers are so confident of the success of this arrangement that it is expected that the new ships will have similar fire-room equipment. Probably the propelling engines will be of the turbine type. In connection with the fuel subject, it is interesting to note that the British admiralty is about to appoint a commission to inquire into the question of liquid fuel and its application to warships.

—*Army and Navy Register*, August 10, 1912.

The Battleship Pennsylvania.—The Navy Department has given out a preliminary description of battleship No. 38, the *Pennsylvania*. The new battleship authorized by act of Congress of August 22, 1912, is to cost, exclusive of armor and armament, in the neighborhood of $7,425,000. The vessel will be the largest of this class yet designed for the United States navy. The plans, which are in course of preparation, contemplate a vessel of the following characteristics: Length, 600 feet; breadth, 97 feet; draft, about 28 feet 6 inches; displacement, about 31,000 tons; main battery of twelve 14-inch guns and four submerged torpedo tubes, supported by a torpedo defense battery of twenty-two 5-inch guns. The vessel will be heavily armored and will have oil-burning boilers of the water-tube type. Several types of machinery are under consideration, but the type to be finally adopted has not yet been definitely determined. The speed will depend upon the selection of machinery, and it is expected that it will be from one-half to one knot in excess of the fastest American ships. A comparison of the lengths of the recent ships laid down will show that the *Pennsylvania* is considerably larger. The length of the *New York* and the *Texas* is 573 feet, while the *Nevada* and *Oklahoma* are 580 feet long. The two ships just going into commission—the *Arkansas* and *Wyoming*—are 562 feet long. The *Pennsylvania* is considered about the largest type of ship which can safely pass through the locks on the Isthmus. The Navy Department was anxious to obtain authorization for a battlecruiser, which is the latest type of war vessel to be developed. It has about 27,000 tons displacement and a speed of 27 or 28 knots. While this vessel costs from 5 to 7 per cent more than a 30,000-ton battleship, it is decidedly superior in point of speed. Great Britain, Germany, and Japan have undertaken the construction of these battlecruisers. They are armed with 13.5-inch or 14-inch guns. It is practically settled that the *Pennsylvania* shall be constructed in a commercial yard and not in one of the navy yards. It is the policy of the Navy to give a large part of the work of battleship construction to private yards in order that these industries may be encouraged and that facilities for battleship construction may be at hand when needed. The announcement of plans and specifications for the benefit of prospective bidders will probably be made soon.

—*Army and Navy Register*, September 21, 1912.

The Four-Gun Turret.—After tenaciously sticking to primary and secondary guns of smaller caliber than most of the first-class naval powers, France has suddenly—doubtless under the influence of its capable Marine Minister, M. Delcasse—decided upon mounting four 12-inch guns in each of the three turrets with which her new battleships are to be fitted. This is an experiment of first-class importance which will be closely watched by the rest of Europe, and by no one more closely than our own warship designers, who have steadily refused, so far, to depart from the twin-turret system of mounting. Although the authorities deny it, there has undoubtedly been trouble in regard to mounting three guns in the turrets of the Austrian Dreadnoughts. The gunmountings themselves are of extraordinary weight, and this difficulty will be greatly intensified if a fourth gun be added by our friends the French. Yet their engineers have on many occasions startled the world by their ingenuity and practical proposals, and they may yet show the way in four-gun turrets without having any abnormal difficulties, outside of those which are bound to attach themselves to any such bold proposal as this. The smashing power of a comparatively short ship with three four-gun turrets mounted on the middle line, would be enormous, as no less than twelve primary guns would be available for every broadside the captain wished to fire; while four-gun salvos ahead or astern would also form a feature of the plan of concentration.—*United Service Gazette*, August 1, 1912.

Victory of Secondary Armament Advocates.—The question of secondary armaments is coming in for a good deal of discussion in the gunnery circles of the Navy just now owing to the subject having been brought into prominence by the report that the battleship *Delhi* is to have secondary guns of six-inch caliber. There are two schools of thought respecting the arming of capital ships in the British Navy. One school holds that battles should and will, as far as possible, be fought at long range, and by big guns controlled by the gunnery officers at the controlling platforms aloft or in safer positions at less altitude. The other school believes that determined captains will close their ships to moderate range as early as practicable, and remain there to settle the action chiefly by broadside fire. It is the latter school who call for a powerful secondary armament, and who contend that a salvo of fourteen 6-inch projectiles, each weighing 100 pounds will, if well directed, do the enemy infinitely more harm, both morally and materially, than a single well-directed shot from a 13.5-inch gun weighing 1400 pounds—equivalent in weight to the salvo from the fourteen guns in the secondary battery. This assumption is based on the range being a moderate one—say not more than 5,000 yards. On the side of the secondary gun school there stand nearly all the first-class naval powers of the world; including Japan and Russia, with the latest experience of ocean warfare. This school has argued in vain, however, since the name ship of the Dreadnoughts was built, until the laying of the keel-plates of the Dreadnought, but having now been beaten, the all-big-gun advocates are stridently pushing forward all the points to be made on their side, such as the "smashing blow," etc.

—*United Service Gazette*, July 18, 1912.

The 6-Inch Gun as a Secondary Weapon.—The great increase in the size of foreign destroyers is said to be back of the determination of the British admiralty to re-adopt the 6-inch gun. When the original Dreadnought was laid down the foreign destroyers were only of 400 to 500 tons displacement, whereas Great Britain was building boats of a much larger and faster type against which the 3-inch gun would be useless. The 6-inch gun was first omitted entirely as a secondary weapon in the *Lord Nelson* design, and as an anti-torpedoboat weapon the 3-inch 12-pounder gun superseded it entirely in 1904 and 1905. The extended use of heavier small weapons in the primary vessels of the Powers has recently been very marked. In the United States the *Michigan* class, completed in 1909, followed the original Dreadnought in having 3-inch anti-torpedo weapons, but during the succeeding years this armament has increased rapidly from fourteen 5-inch in the *Delaware* and sixteen in the *Florida* to twenty-one and twenty-two, respectively, in the *Arkansas* and *New York*. Of course, the temptation to go beyond the 6-inch is always offset by the difficulty of detecting, for range finding purposes, the difference between the splash of their projectiles and those of the larger guns. With the multiplicity of splashes such as one might obtain on a calm day more careful sighting for the bigger and more destructive guns became increasingly difficult. The London *Engineer* has done some figuring on this subject and arrives at these conclusions: "From the results of gunlayer tests the last few years we may take the relative rate of fire of 4-inch, 4.7-inch and 6-inch guns as being, respectively, about ten, eight and six rounds per minute, with a corresponding average accuracy of 4.25, 3.25 and 3.8 hits per minute. If we assume that torpedo craft will discharge their torpedoes at a range of 1,000 yards, then boats sighted at 5,000 yards off and advancing at thirty knots might be considered likely to receive approximately 17, 13 or 15 hits per gun, respectively, in the four minutes that they would take to cover the intervening distance. On this basis the 6-inch weapon appears much more suitable than the smaller weapons." From the figures given some may not see the superiority of the 6-inch. "The weight of the 6-inch," it continues, "and the space it occupies tend to neutralize its advantages in some respects; the 50-caliber high velocity 4-inch weighs but one-quarter of what the 6-inch gun does. But with the greatly increasing size of torpedo craft a heavier projectile than 30 pounds is necessary, and a more powerful and longer range weapon also."

—*Army and Navy Journal*, July 13, 1912.

Fortification of the Panama Canal.—It will be impossible to fortify the Panama Canal by the time it is to be opened. The delay of Congress in adopting a plan for the fortification of the great waterway has kept back the work of building the new guns and they will not be completed in time to install them before the canal opens. Although the Ordnance Department of the Army is pushing the work on the plans for the carriage of the 16-inch gun, it will be two years before the War Department will be ready to ship it to the Canal Zone. Within six months the Ordnance Department expects to be able to send a 14-inch gun and some of the smaller guns to the Canal Zone. It will be a year before any of them are installed. This delay in the fortification of the Canal is a dangerous policy. No large concern will wait a year or two after it has erected a large building before placing insurance on it. The fortification of the canal is more to the country than insurance to the building of a private concern. Without fortifications the canal is not only placed at the mercy of an enemy in the event of war, but a condition is created which might force this country to accept peace terms under humiliating conditions. Of course there does not seem to be an immediate prospect of war, but a well managed corporation does not wait until its building is on fire before providing protection for it.

—*Army and Navy Journal*, August 3, 1912.

*The Relation of the Horsepower to the Kilowatt.**—There was, before 1911 no precise definition of the horsepower that was generally accepted and authoritative, and different equivalents of this unit in watts are given by various books. The most frequently used equivalent in watts, both in the United States and England, has been the round number, 746 watts; and in 1911 the American Institute of Electrical Engineers adopted this as the exact value of the horsepower. It is obviously desirable that a unit of power should not vary from place to place, and the horsepower thus defined as a fixed number of watts does indeed represent the same rate of work at all places. Inasmuch as the "pound" weight, as a unit of force, varies in value as g the acceleration of gravity varies, the number of foot-pounds per second in a horsepower accordingly varies with the latitude and altitude. It is equal to 550 foot-pounds per second at 50° latitude and sea level, approximately the location of London, where the original experiments were made by James Watt to determine the magnitude of the horsepower.

---

* **Abstract of Circular of the Bureau of Standards No. 34; June, 1912.**

The "continental horsepower," which is used on the continent of Europe, differs from the English and American horsepower by more than 1 per cent, its usual equivalent in watts being 736. This difference is historically due to the confusion existing in weights and measures about a hundred years ago. After the metric system had come into use in Europe, the various values of the horsepower in terms of local feet and pounds were reduced to metric units and were rounded off to 75 kilogram-meters per second, although the original English value was equivalent to 76.041 kilogram-meters per second. Since a unit of power should represent the same rate of work at all places, the "continental horse-power" is best defined as 736 watts; this is equivalent to 75 kilogram-meters per second at latitude 52° 30′, or Berlin. The circular gives tables showing the variation with latitude and altitude of the number of foot-pounds per second and of kilogram-meters per second in the two different horsepowers.

These values, 746 and 736 watts, were adopted as early as 1873 by a committee of the British Association for the Advancement of Science. The value, 0.746 kilowatt, will be used in future publications of the Bureau of Standards as the exact equivalent of the English and American horsepower. It is recognized, however, that modern engineering practice is constantly tending away from the horsepower and toward the kilowatt. The Bureau of Standards and the Standards Committee of the American Institute of Electrical Engineers recommend the kilowatt for use generally instead of the horsepower as the unit of power.—*Science*, July 19, 1912.

Guiding Torpedoes from Aircraft.—In patent No. 1,032,394 Bradley A. Fiske, U. S. Navy, presents a method and apparatus for delivering submarine torpedoes from aircraft in which the torpedo is first transported through the air to a point of desired proximity to a target by means of an aircraft and then the torpedo is trained in the desired direction, after which the propelling mechanism of the torpedo is started, and then the torpedo is released to fall by gravity to the water. In the apparatus, a strap is employed for retaining the torpedo below the aircraft and a manually controlled lever releases a latch for said strap, the said lever also actuating transmitting mechanism to operate the starting device for the propelling mechanism of the torpedo.
—*Scientific American*, August 3, 1912.

Universal Shell.—It is reported that a combined shrapnel and high-explosive shell has been adopted as the sole projectile of the new Austrian light field howitzer. In addition to its use as a time shrapnel or percussion common shell, this projectile has a third method of action: when burst as a shrapnel in air the head flies forward and acts as an efficient percussion shell on its own account. At recent Austrian experiments it was found that the shrapnel effect, as compared with ordinary shrapel, was proportional to the weight of the bullets; that is, about 7 per cent less than that of an ordinary shrapnel of the same total weight. The effect of the universal shell against shielded guns was very good, as the heads were effective in piercing the gun-shields and killing the men behind them.
—*Army and Navy Gazette*, August 10, 1912.

NOTICES

MILITARY INVENTIONS

Arrangements have been made with H. B. Willson & Co., Patent Attorneys, 715 Eighth St., N. W., Washington, D. C., to furnish us lists of patents of interest from a military point of view. These will appear in each issue of the JOURNAL hereafter, if they seem to be of sufficient interest to our readers to pay for the space used. Give number of patent and enclose 10 cents to Willson & Co., for complete copy of any patent in which you are interested.

AERONAUTICS

1,033,827	Flying Machine, T. F. Pearson, Billerica, Mass., Assignor to B. B. Hart, Lowell, Mass.
1,034,042	Flying Machine, I. H. Story, Ambleside, Eng.
1,034,120	Flying Machine, J. J. V. Kaulynskas, Philadelphia, Pa.
1,034,142	Life Saving Device, J.J. Rectenwald, Mount Oliver,Borough, Pa.
1,034,242	Multiplex-Power Flying Machine, O. W. Johnson, Goldfield, Nev.
1,034,245	Flying Machine, C. V. Johnson, Geneva, Ohio.
1,034,257	Aeroplane, V. H. Latendorf, Bayonne, N. J.
1,038,602	Airship, C. A. Kuenzel, Buena Vista, Colo.
1,038,633	Flying Machine, Gory O'Bryan, Louisville, Ky.
1,038,964	Flying Machine, C. T. Rogers, Newton, Ala., Assignor to J. W. Rogers, Newton, Ala.
1,037,214	Monoplane, Anthelme Desaye, Clifton, N. J.
1,037,278	Aeroplane, J. R. Martin, St. Louis, Mo.
1,037,353	Heavier Than Air Flying Machine, A. B. Springstead, Kalamazoo, Mich.
1,037,411	Aeroplane, J. H. S. Bartholomew, Occidental, and E. F. Heath, Santa Rosa, Cal.
1,037,450	Airship, J. J. Daniels, New Rochelle, N. Y.
1,037,651	Automatic Balancing Aeroplane, Robt. McMullen, Fremantle, Western Australia, Australia.
1,037,657	Aeroplane, A. E. Petrucci, New York, N. Y.
1,037,658	Aeroplane, J. A. Rabbitt, Yokohama, Japan.
1,037,704	Aeroplane, S. S. Yarrington, Wilmington, Del.
1,037,749	Aeroplane, Alexy Feall, Los Angeles, Cal.
1,037,800	Flying Machine, F. L. Schaufler, Mattoon, Ill., Assignor to Nat'l Aerial Navagation and Equipment Co., Cullman, Ala.
1,037,804	Flying Machine, T. A. Tanner, Flint, Mich., Assignor to B. F. Miller, Jr., Flint, Mich.
1,033,148	Launching Device for Flying Machines, W. A. Bond, Lynn, Mass., Assignor to A. M' Johnson, Lynn, Mass.
1,033,186	Airship, August Merckens, New York, N. Y.
1,033,234	Airship, Chas. Ehlers, West Hoboken, N. J.
1,033,287	Aeroplane, Gustav Staib, Port Richmond, N. Y.

1,033,452	Flying-Machine, P. A. Nilson, Philadelphia, Pa.
1,032,400	Flying-Machine, G. T. Peay, Jr., Provo, Utah.
1,033,510	Airship, R. R. Zell, Birmingham, Ala., Assignor to Zell Automobile Co., Birmingham, Ala.
1,033,646	Flying-Machine, J. W. Wilson, Boston, Mass.
1,033,710	Aeroplane Balancing and Controlling Means, J. J. Lauer, Alturas, Cal.
1,034,429	Flying Machine, Thomas A. Dring, Trowbridge, England.
1,034,430	Flying Machine, Thomas A. Dring, Trowbridge, England.
1,034,544	Aeroplane, M. H. Webster, Evanston, Ill.
1,034,556	Aeroplane, M. J. Zmujdzinowicz, Cleveland, Ohio.
1,034,578	Flying Machine, Julius Brown, Peekskill, N. Y.
1,034,638	Aeroplane, G. F. Mentz, Attica, N. Y., Assignor to United Airation, Co.
1,034,655	Aeroplane, P. D. Smith, Oakland, Cal.
1,034,700	Device for Facilitating the Alighting of Aeroplanes on Moving Warships, Francesco Filiasi, Naples, Italy.
1,034,718	Aeroplane, H. J. List, San Francisco, Cal.
1,034,958	Flying Machine, R. L. Bernard, Mountain View, Cal.
1,035,103	Aeroplane, Gerhardt Rasmussen, New York, N. Y.
1,035,396	Flying Machine, F. W. Stodder, W. Somerville, Mass.
1,035,479	Propelling Device for Airships, Anselm Schaeffer, Elizabeth, N. J.
1,035,560	Method of Refilling Aerial Vehicles During a Flight, Hugo Erdmann, Charlottenburg, Germany.
1,035,583	Flying Machine, C. A. Hamilton, New York, N. Y.
1,035,660	Aeroplane, D. G. Terzian, Washington, D. C.
1,035,687	Flying Machine, T. W. Carey, Jr., New Orleans, La.
1,035,701	Aeroplane, C. A. Beauchamp, Pickard Hawkins, and Bertram Ogvie, Napier, New Zealand, Assignor to C. H. Nairn, Pourerere, Hawkes Bay, New Zealand.
1,035,794	Aeroplane, G. H. Kellogg, Syracuse, N. Y.
1,035,795	Balancing Device for Airships, G. H. Kellogg, Syracuse, N. Y.
1,035,858	Flying-Machine, W. B. Clements, Veedum, Wis.
1,036,033	Airship, H. La V. Twining, Los Angeles, Cal.
1,036,044	Rotable Plane, R. D. Wheeler, Sydney, New South Wales, and B. L. Wheeler, Melbourne, Victoria, Australia.
1,036,178	Flying-Machine, J. A. Blondin, Los Angeles, Cal.
1,036,249	Flying Machine, C. V. Johnson, Goldfield, Nev.
1,036,287	Flying Machine, John Malpkovich, New York, N. Y.
1,036,431	Propeller for Aerial Vessels, Jas. Bowie, Edinburg, Scotland.
1,036,532	Shelter for Dirigible Balloons, Airships, and the like, R. A. Katz, Berlin, Germany.
1,036,667	Aerial Machine, C. L. Matson, Chicago, Ill.
1,036,732	Flying-Machine, David Segal, Washington, D. C., Assignor to Jacob Segal, Long Island City, N. Y.
1,036,780	Airship, J. C. Bauer, Cleveland, Ohio.
1,036,964	Airship, J. A. Conterio, Santa Barbara, Cal.
1,036,781	Airship, J. C. Bauer, Cleveland, Ohio.
1,037,050	Flying Machines, Jules Raclot, and Camille Enderlin, St. Maur des Fosses, France.
1,037,136	Airship, J. G. E. Danielson, Omaha, Nebraska.
1,038,435	Aeroplane, B. J. Pressey, Newport News, Va.

1,038,507	Elastically Connected Surfaces for Insuring the Stability of Airships, Aeroplanes, and Submarine Boats, G. A. Grocco and Attario Ricaldoni, Rome, Italy.
1,037,853	Aeroplane, E. S. Bennett, New York, N. Y.
1,037,853	Aero Safety Device, W. H. Lowry, Jacksonville, Fla.
1,037,959	Parachute Device, Lee Miller, Chicago, Ill.
1,037,973	Aeroplane Suspension-Railway, W. W. Herry, New York, N. Y., Assignor to P. H. Pages, New York, N. Y.
1,038,073	Flying-Machine, S. H. Benoist, Los Angeles, Cal., Marie E. Benoist, administratrix of said S. H. Benoist, deceased.
1,038,089	Aerial Track, Bernard Clausen, Dortmund, Germany, Assignor to The Firm of Ludw. Heisse, Dortmund, Germany.
1,038,106	Airship, E. F. Fisher, San Diego, Cal., Assignor to R. L. Fisher, Raymond, Wash.
1,038,168	Flying-Machine, J. E. Marshall, New York, N. Y.
1,038,196	Safety Device for Flying Machine, J. G. Quigg, Pittsburg, Pa.
1,038,306	Aeroplane, D. A. Davidson, Richmond, Va.
1,038,317	Plane for Aeroplanes, F. G. Donner, Pittsburg, Pa.

ARTILLERY

1,033,625	Automatic Gun, Franz Schmidt, Dusseldorf, Germany, Assignor to Rheinische Metallwaaren und Maschinfabrik, Dusseldorf-Dorendorf, Germany.
1,034,171	Recoil Mechanism for Guns, Karl Voller, Dusseldorf, Germany.

EXPLOSIVES

1,038,187	Explosive, J. F. O'Brien, Chicago, Ill.
1,038,188	Explosive, J. F. O'Brien, Chicago, Ill.
1,038,292	Safety Explosive, Norbert Clipek, Vienna, Austria-Hungary.
1,038,400	Aerial Torpedo, J. A. Linsmeyer, Vienna, Austria-Hungary.
1,038,847	Method of Producing Explosives Containing Common Resin, O. B. Carlson, Mansvo, Avesta, Sweden, Assignor to O. F. Carlson, Stockholm, Sweden.
1,033,537	Safety Explosive, Norbert Ceipek, Vienna, Austria-Hungary.
1,033,285	Explosive Charge, Ernst Sokolowski, Hamburg, Germany, Assignor to E. I. de Pont de Nemours Powder Co., Wilmington, Delaware.
1,034,160	Electric Primer, H. W. Starkweather, New Haven, Conn., Assignor to Winchester Repeating Arms Co., New Haven, Conn.
1,037,811	Automatically-Operating Key for Setting the Timing-Rings of Fuses for Shells or the like, Karl Voller, Dusseldorf, Germany.
1,036,906	Granular Explosive, Especially Suitable for the Preparation of Presses Pieces, and Method of Making the Same, Otto Reuter, Schlebusch-Manfort, Germany, Assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del.

SHIPS (NAVAL), ARMOR, ETC.

1,037,519	Submarine or Submergible Boat, E. L. Peacock, Bridgeport, Conn., Assignor to The Lake Torpedo Boat Co., Bridegport, Conn.
1,035,021	Safety Weight for Submarine Vessels, M. A. Laubeuf, Paris, France.

1,037,191	Conning Mechanism for Submarine Boats, T. S. Bailey, Quincy, Mass., Assignor to Electric Boat Co., New York, N. Y.
1,035,573	Armor Plate, Louis Gathmann, Washington, D. C.
1,035,122	Apparatus for Determining the Moment when a Ship's Gun Passes through a Predetermined Elevation, L. J. Mautner, Vienna, Austria-Hungary.

SIGHTS, ETC.

1,034,804	Lookout-Telescope, Albert Konig, Jena, Germany, Assignor to The Firm of Carl Zeiss, Jena, Germany.
1,034,925	Gun Sight, E. J. D. Newitt, London, England, Assignor to Remington Arms and Ammunition Co., New York, N. Y.
1,033,494	Sighting Device for Guns, Pelopidas Tsiekalas, Athens, Greece.
1,033,495	Sight for Firearms, E. R. Tufts, Pittsburgh, Pa., Assignor to C. E. Greenough, New York, N. Y.

SIGNALLING

1,035,291	Submarine Sound Signaling Apparatus, E. C. Wood, Somerville, Mass., Assignor to Submarine Signal Co., Waterville, Me.
1,035,292	Sounder, E. C. Wood, Somerville, Mass, Assignor to Submarine Signal Co., Waterville, Me.
1,036,265	Apparatus for Submarine Telegraphy and Signaling, Eugene Klupathy and Christian Berger, Budapest, Austria-Hungary.
1,038,506	Apparatus for Aerial Signaling and Similar Purposes, W. G. Spiegel, New York, N. Y.

SMALL ARMS, TARGETS, ETC.

1,035,498	Clip for Attaching the Lock-plates of Guns, H. A. A. Thorn, Haymarket, London, England.
1,035,148	Firearm, A. H. Bishop, Chicago, Ill.
1,035,210	Ejector Device for Automatic Firearms, Paul Mauser, Oberndorf-on-the-Neckar, Germany.
1,038,007	Cartridge-Shell, L. A. Sherman and H. E. Sherman, Kansas City, Mo.
1,038,078	Cartridge-Feed Belt, Nils Bjorgum, Asker, near Christiania, Nor.
1,035,940	Ejecting Mechanism for Drop-down Small Arms, William Baker, Birmingham, England.
1,035,707	Rifle Wipe Rod, Jos. Hurst, Bessemer, Ala.
1,034,684	Shotgun Shell, W. P. Brown, Minneapolis, Minn.
1,034,750	Automatic-Firearm, W. H. Whittier, Grand Rapids, Mich.
1,035,079	Shotgun Shell, W. P. Brown, Minneapolis, Minn.
1,037,107	Magazine-Firearm, Winchester Bennett, New Haven, Conn., Assignor to Winchester Repeating Arms Co., New Haven, Conn.
1,038,700	Target Trap, J. H. Wilder, Randall, Kans.
1,038,728	Target-Practice Apparatus, H. H. Cummings, Newton, Mass., Assignor to Atlantic National Bank, Providence, R. I.
1,038,555	Automatic Firearm, Rudolf Frommer, Budapest, Austria-Hungary.
1,037,544	Safety Attachment for Firearms, F. T. Russell, Philadelphia, Pa.
1,033,408	Magazine-Firearm, T. C. Johnson, New Haven, Conn., Assignor to Winchester Repeating Arms Co., New Haven, Conn.

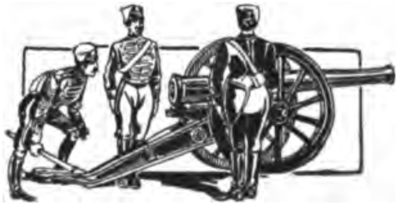
1,037,308	Combined Registering and Feeding Mechanism for Guns, W. P. Pinkston, St. Louis, Mo.
1,037,468	Rifle, P. T. Godsal, Flintshire, near Whitechurch, England.
1,037,468	Wooden Fore Arm for Automatic Firearms, T. C. Johnson, New Haven, Conn., Assignor to Winchester Repeating Arms Co., New Haven, Conn.
1,033,971	Automatic Pistol, J. H. Wesson, Springfield, Mass.
1,034,122	Magazine-Firearm, F. K. Knows, New Haven, Conn., Assignor to Winchester Repeating Arms Co., New Haven, Conn.

SUBMARINE MINES AND TORPEDOES

1,036,080	Apparatus for Generating Motive Fluid for Automobile Torpedoes, G. C. Davidson, Quincy, Mass., Assignor to Electric Boat Co., New York, N. Y.
1,036,081	Motive-Fluid Generating Apparatus for Automobile Torpedoes, G. C. Davidson, Quincy, Mass.,s Asignor to Electric Boat Co., New York, N. Y.
1,036,082	Automobile Torpedo, G. C. Davidson, Quincy, Mass., Assignor to Electric Boat Co., New York, N. Y.
1,033,810	Diving Gear for Torpedoes, F. M. Leavitt, Smithtonn, New York, Assignor to E. W. Bliss Co., Brooklyn, N. Y.
1,035,647	Method of Fire Control for Torpedoes, H. W. Shonnard, E. Orange, N. J.
1,034,999	Device for Destroying Torpedo Nets, Wm. Goldsteyn, Amsterdam, Netherlands.
1,033,993	Launching Torpedoes, G. C. Davidson, Quincy, Mass.

MISCELLANEOUS

1,033,233	Ammunition-Hoisting Gear for Heavy Ordnance, A. T. Dawson, Westminster, London, and Jas. Horne, Barrow-in-Furness, England, Assignors to Vickers, Limited, Westminster, England.
1,036,150	Life-Saving Apparatus for Sugmarines, Marinus Reyngoudt, Hasbrouck Heights, N. J.
1,036,171	Means for Preventing the Erosion of Guns, A. A. Ackerman, U. S. Navy.
1,036,383	Composition of Matter Used for Cleaning Gun-Barrels, Alendo Tromsness, Minneapolis, Minn.
1,038,588	Apparatus for Coaling Ships, M. S. Iverson, New York, N. Y.
1,035.124	Battle-Light, E. J. D. Jewitt, London, England, Assignor to Remington Arms and Ammunition Co., Ilion, N. Y.
1,033,624	Gun, Louis Schmeisser, Erfurt, Germany.



BOOK REVIEWS

Archives Militaires. Paris: Librairie Militaire Berger-Levrault, 5-7 Rue des Beaux-Arts. 8½"x10½". 156 pp. il. Quarterly. Per year, 14 fr.

To the exchange table of the JOURNAL OF THE UNITED STATES ARTILLERY has come the first number, that for January-March, 1912, of *Les Archives Militaires* (Librairie Militaire Berger-Levrault, 5-7 Rue des Beaux-Arts, Paris) which is described on its cover as a quarterly review of progress and changes in organization, armament, equipment, instruction, and tactics of all armies of the world, and of contemporary war news, followed by a critical and bibliographical review of military literature.

The articles are arranged in alphabetical order, making of the review a virtual quarterly military encyclopedia. For that reason, while we have listed *Les Archives Militaire* in the periodicals cited in the *Index to Current Military Literatures* published in connection with the JOURNAL, yet references in the *Index* to articles appearing in *Les Archives* will be comparatively few. In fact, since *Les Archives* is itself prepared for ready reference and is a periodical devoted to military review, references to it will be made only to call attention to especially notable articles directly related to the coast artillery.

It should be remarked that the articles contained in *Les Archives* are not discussions but statements of fact.

✤ ✤ ✤

Nautical Phraseology in English, French, Spanish and German. Prepared in the Department of Modern Languages, U. S. Naval Academy. Baltimore, Maryland: The Lord Baltimore Press. For use of the U. S. Naval Academy. 4¾" x 7". 111 pp. 1911. Cloth. Price, $1.25, postpaid.

This book has been prepared in the Department of Modern Languages in the U. S. Naval Academy for the use of midshipmen of the first class. It is more or less unique and is well designed to accomplish its purpose, which is to enable one speaking English, French, Spanish, or German, to exchange civilities and to carry on nautical conversation with another who speaks a different one of those languages. It is obvious that such a book would be of value in Coast Artillery posts which are located in harbors where foreign ships of war are frequent visitors; for Americans, in or out of the service, must admit that one of their greatest weaknesses is lack of a speaking knowledge of foreign languages. We study them it is true, but few of us speak them.

However, Nautical Phraseology was not written for the Coast Artillery. It is distinctively a naval book and is so arranged that an officer can go abroad with his ship and visit the ports of France, Germany, and Spain,—carry on ordinary conversation with his brother officers, send and receive invitations, transmit and comprehend messages in naval parlance with assurance and without embarrassment. In addition to the various phrases there is a table of corresponding ranks of officers of the American, French, Spanish, German and British navies and a technical vocabulary containing words most frequently needed in nautical conversation. The book is neatly arranged and easily accomplishes its purpose.

◆ ◆ ◆

Historical Papers on Modern Explosives. By G. W. Mac Donald. New York: Macmillan Company; London: Whittaker & Company. 6¼" x 10". 192 pp. Price, $2.50.

The collection of papers in this volume traces the history of modern explosives from the discovery of fulminate of mercury in 1800 to the end of the last century, comprises all the classics on the subject, especially those of Schœnbein, Abel and Nobel, and constitutes a valuable contribution to the history of the remarkable abvance made in the development of explosives during the latter half of the nineteenth century.

To the student of modern explosives this work will serve as a foundation, and to the practical worker in this field it will serve as a useful reference book, outlining the great steps already taken by investigators and pointing the way to further improvements.

The separate articles herein contained have all appeared at various times in other publications, such as *Arms and Explosives*, *Philosophical Transactions of the Royal Society*, *Poggendorff's Annalen* and *Comptes Rendus*, but in this volume they are for the first time collected together and presented in readable form in their historical sequence. Moreover, the voluminous work of Abel has been greatly compressed and arranged systematically under suitable headings, and its complex tables have been reduced to clear statements of actual results and pertinent facts.

Besides the classics above referred to, the collection of papers contains considerable other matter of interest relating to the general subject and illustrating its historical development. For example, in connection with Schœnbein's discovery of guncotton there are chapters on the development of this subject in France, in Scotland and in England, as well as accounts of the manufacture of guncotton in Austria and at Waltham Abbey. Again, in connection with Sobrero's discovery of nitroglycerine in 1847, there are (besides the acounts of Nobel's patents) chapters on the development of the subject in Holland and England, as well as on the analysis, composition and decomposition of nitroglycerine.

The volume is well printed in clear type and substantially bound, and constitutes a valuable number of *The Specialists' Series* and will be useful to all interested in explosives.

◆ ◆ ◆

Stories of Some Shoots or the Chronicles of a Gratified Gunner. By James A. Drain. Washington, D. C.: Arms and The Man, 1502 H. St., N. W. 5½" by 8¼". 114 pp. Cloth. 1912. Price, $1.25 net.

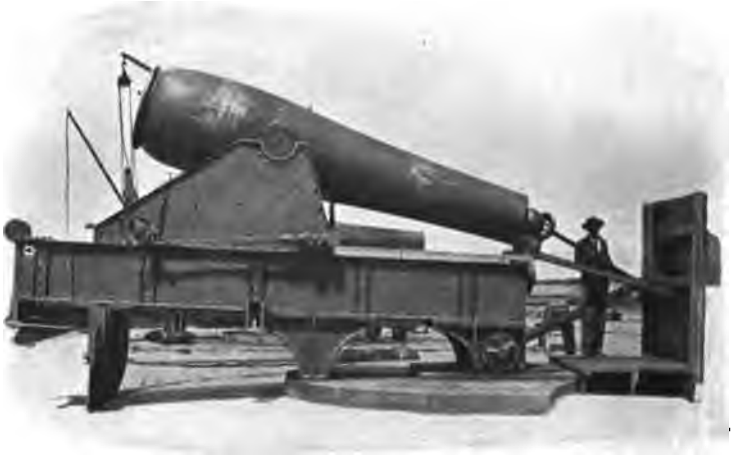
Told with a detail so dear to a sportsman's heart, "Stories of Some Shoots" vividly portrays the extent, and depths, to which the stifled "sporting instinct," that combination of the various instincts for fresh air, destruction, physical prowess, emulation and devotion, may carry its possessors.

General Drain has evidently striven for a description of things as he found them during his Scotch and English shooting experiences of 1911; nothing is glossed over, and little which is open to criticism is excused.

The line of ten guns, about twenty-five yards apart, with three or four beaters between every two, and the loader for each gun behind his principal; the rabbit tight fence around the warren, with its stopped burrows and its temporary brush refuges, which are lifted with poles as the line advances to frighten out the rabbits and invite the fusilade; the hen hatched mallard ducks, trained to fly between certain feeding points and their home waters; their release, at trumpet signals, from the wire-netted inclosure in which they have been cooped, to follow the line of flight in which they have been practiced and on which the numbered shooting stands have now been installed, are short descriptions of the machinery which guarantees to the "sportsman" a shot, or as many shots as he likes, when and where he desires. No wonder that after the morning rabbit slaughter there is yet time before 4 o'clock to bag 650 ducks, together with "a few more picked up later." "Fly as hard and high as they might the five guns eventually disposed of practically all of them."

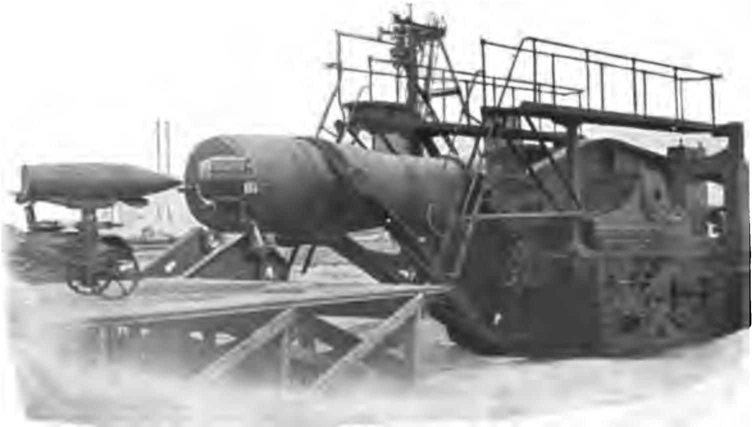
When "Allen, the butler from the Castle and his troop of footman satellites had set up trestles and laid a damask draped table" where the five hungry "sportsmen" sat down to a piping hot array of luscious viands completed by some old Port and an exceptionally good Havana, small wonder that the party was left "in almost too good a humor to care for more shooting" or that it appeared to be a sufficient hardship that this Lucullus feast was spread "on the open ground, roofed only by the gray sky."

Though certain incidents, hard to forget and harder still to reconcile with American ideas, predominate, yet the sprightly and entertaining style, the descriptions of a true nature lover, and the touches which show that the writer has been trained in a harder and less enervating school, make this little volume happy and entertaining; while the friends of General Drain feel that he had more in mind the comfort and charm of upper class living in the "Right little, tight little Island," the good fellowship and princely hospitality he experienced, and the novelty of environment and conditions which he met, when he records his description thereof as "The Chronicles of a Gratified Gunner."



1195

15-Inch Smooth Bore Gun Being Loaded With Spherical Projectile.
(Typical of 1892.)



1195

14-Inch B. L. Rifle on Disappearing Carriage with "Long Nosed" Projectile in Position for Loading.
(1912.)

JOURNAL
OF THE
UNITED STATES ARTILLERY

"La guerre est un métier pour les ignorans
et une Science pour les habiles gens."

Vol. 38 No. 3 NOVEMBER—DECEMBER, 1912 Whole No. 117

ARMOR AND SHIPS

A BRIEF RÉSUMÉ OF TWENTY YEARS PROGRESS AND ITS EFFECT ON COAST DEFENSE

By Captain JOHN W. GULICK, Coast Artillery Corps

In examining the files of the Journal U. S. Artillery, 1892-1911, one is impressed with the great mass of current information which has been placed before the readers of the Journal on the general subject of Armor and Ships. In fact, no event in the progress of naval affairs has been overlooked, and with the limited space allòtted this paper nothing more than a brief résumé of progress during the past twenty years is considered practicable or desirable. In the Journal, No. 2, Vol. I, and No. 4, Vol. II, may be found two notable articles on armor, armor attack, and armored ships*. In these articles the contest between guns and armor and the characteristics of the principal fighting ships of the world are ably reviewed from 1854 to 1893. These articles possess more than ordinary interest for the coast artilleryman, in that the importance of the subject is fully recognized and the conclusions of the writer are substantiated by a thorough discussion.

---

* "Seacoast Guns and Steel Armor" and "Notes on Armor" by E. M. Weaver, 1st Lieut. and R. Q. M., 2d U. S. Artillery, now Brigadier General and Chief of Coast Artillery, U. S. A.

ARMOR

At the time the articles above referred to were written, the Annapolis and Ochta trials of 1890 had established the superiority of the homogeneous nickel-steel plate over the compound plate with hard-steel face and wrought-iron back, when attacked by chilled cast-iron projectiles, that armor being superior to such projectiles.

About the same time, however, Holtzer in France and Hadfield in England successfully produced forged, chrome-steel, armor-piercing projectiles, which marked the downfall of the steel and compound plates and restored the attack to the same relative position it had held ten years before. Figures 1 and 2 show typical plates of about this period.

The next important advance in armor was the introduction of Harvey Cemented Armor, in which the compound armor principle was perfected in a homogeneous plate. This was accomplished by the application of the well known principle of cementation, or face hardening, to steel or nickel-steel plates, and was the invention of an American, Mr. H. A. Harvey of the Harvey Steel Company of Newark, N. J. Harvey Nickel-Steel Cemented Armor easily established its superiority over any armor previously tested. The first ships to which it was applied were the U. S. S. *Oregon* and *Brooklyn.*

In 1895, when there were not more than half a dozen ships in the world which had benefited by the Harvey process, Krupp came forward with a method of cementation which for many years stood unrivaled and has only recently been equaled by other processes, which are probably similar in principle. The superiority of Krupp armor was not due essentially to its chemical composition, although chrome and nickel predominated, but to its "*treatment,*" or manner of heating and cooling, the differential heat treatment being a feature of the Krupp process.

Figure 3, shows the high development of a typical Krupp Cemented plate produced by the Bethlehem Steel Company and used for acceptance test of projectiles. This plate is a standard Krupp plate of recent manufacture and is 14.0 feet, by 7 feet 6 inches, by 6 inches. It has been attacked 31 times and perforated 29 times. The impacts all show the characteristic Krupp appearance; and in some cases, notably at the two holes to the right and below the wooden brace, though the wall was not more than one-half caliber thick, it was not cracked.

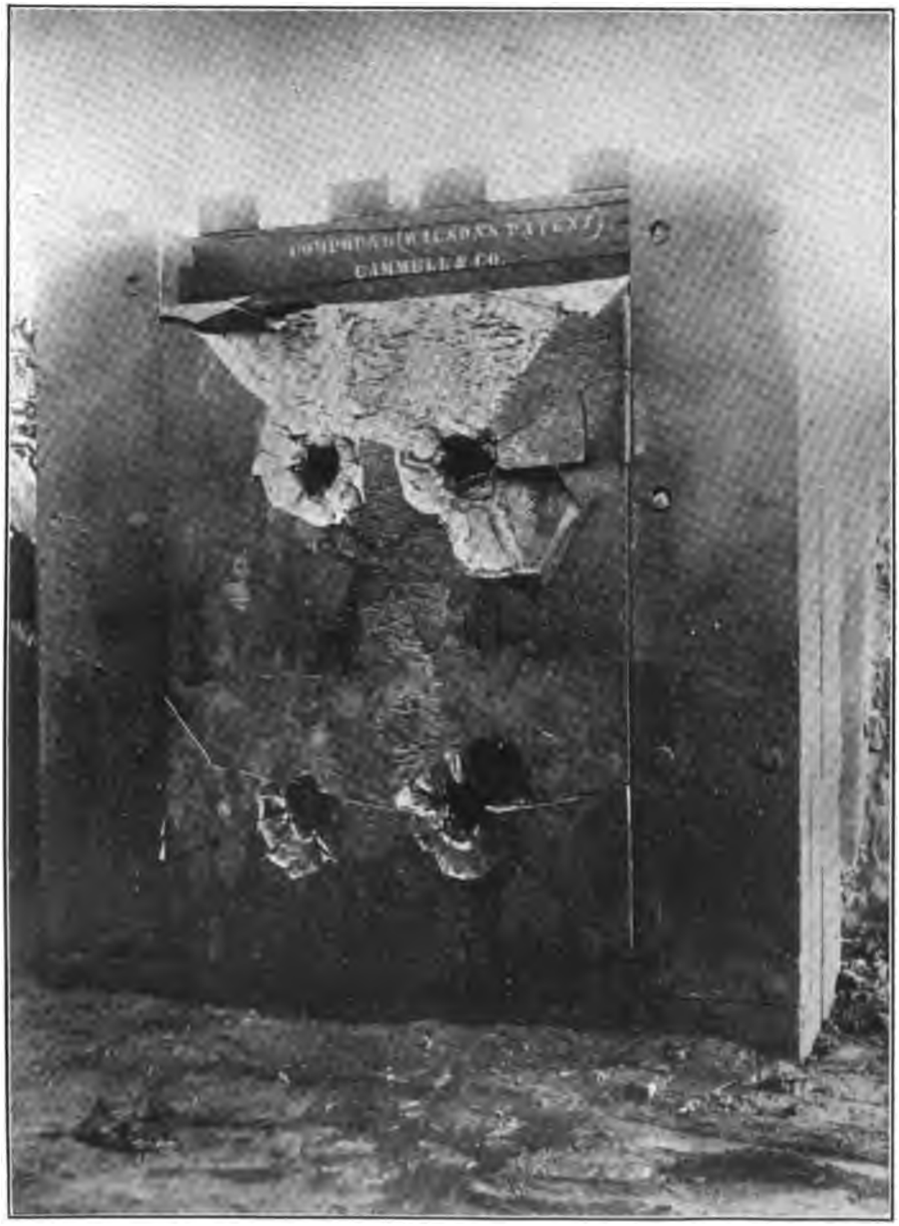


FIG. 1. 1196

Ballistic test of compound armor plate

The relative resistance of the different classes of armor (1892-1900), when attacked by uncapped projectiles, is shown by Figure 4, the standard of comparison, being the usual homogeneous wrought-iron plate with the caliber of the projectile just equaling the thickness of the plate.

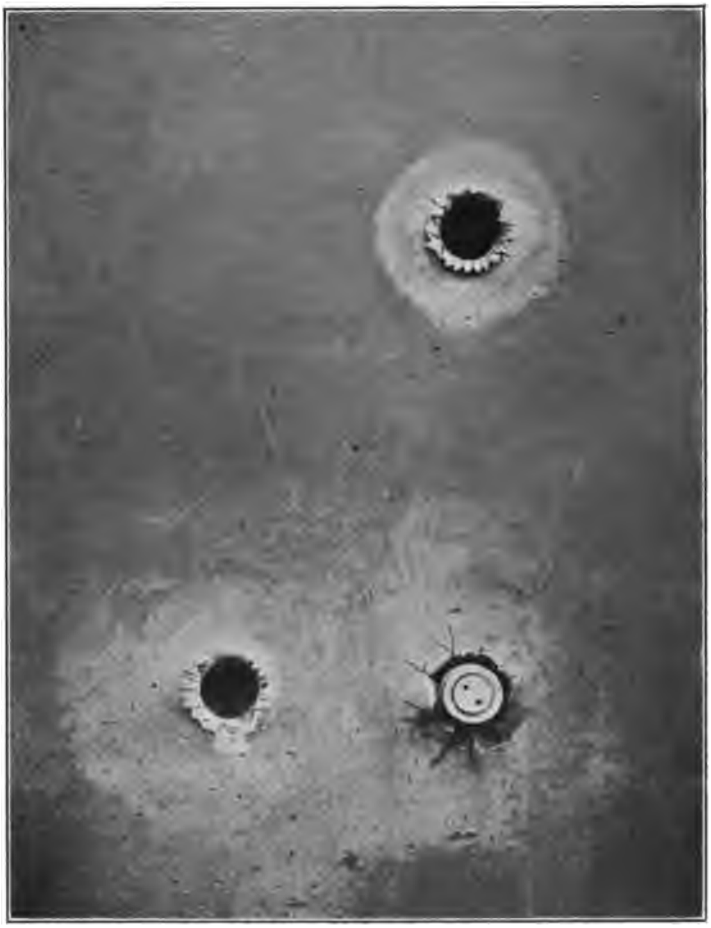


FIG. 2. 1197

Çreusôt steel plate

CAPPED PROJECTILES

In 1877 it was found that a chilled shot which was defeated by a compound plate would perforate, when an additional 2.5 inches of iron was placed in front of the plate. In 1894 ad-

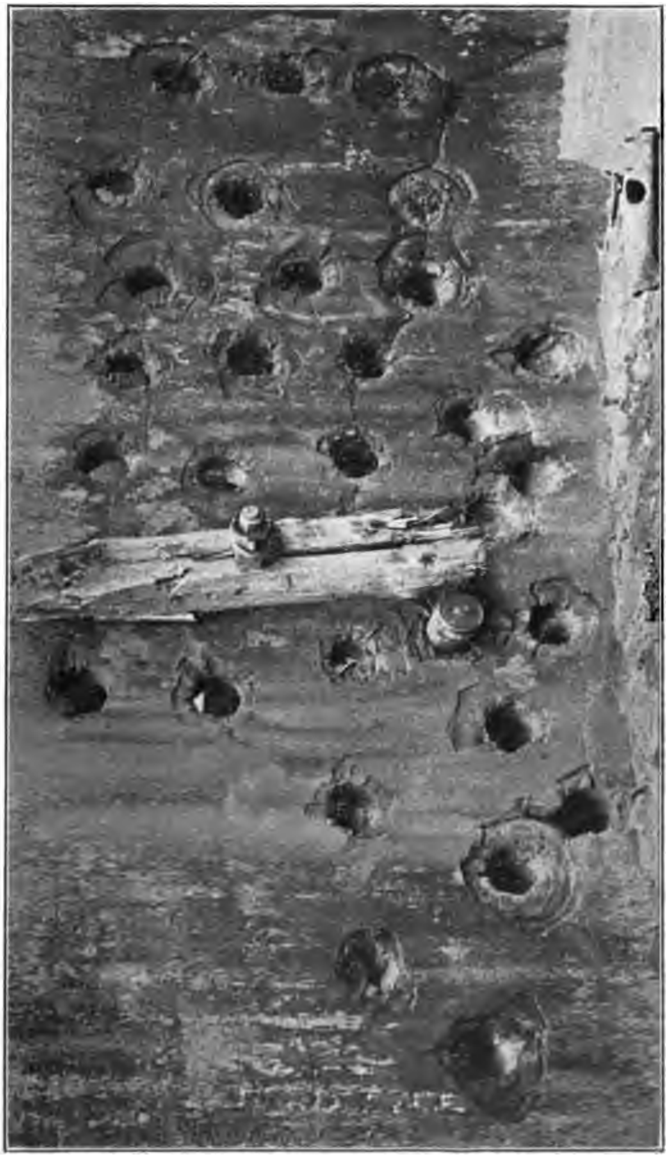


FIG. 3.
Typical Krupp plate

vantage was taken of this knowledge to cover the point of the projectile with a cap of mild steel, which materially reduced the resisting power of hard-faced armor. But, although experiments were undertaken at once by all naval powers, it was not until about 1901 that the utility of the cap was fully recognized.

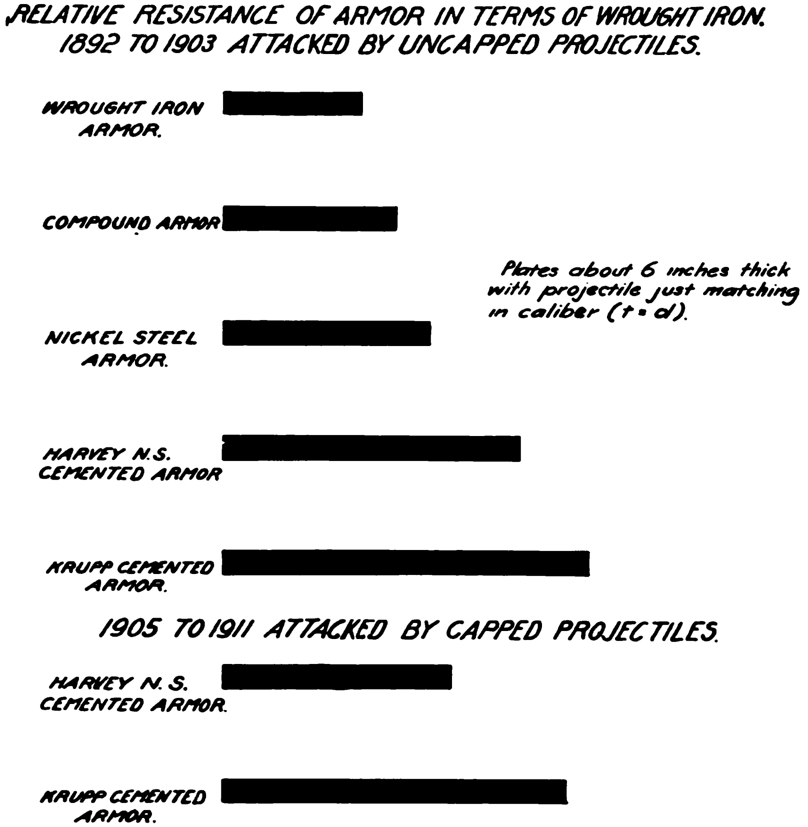


FIG. 4. 1199

In October and December of that year an important trial which illustrated the efficiency of the cap was held at Messrs. Vickers' range at Eskmeals, when a 6-inch hard-faced plate was attacked by 6-inch uncapped projectiles, weight 100 lbs., with the following results:

In four shots fired in October with striking velocities varying from 1996 to 2177 f.s., the projectile was wrecked on the face of the plate. In the fifth shot, also fired in October, with a striking velocity of 2261 f.s., the projectile just perforated the plate. The plate was of excellent quality as shown by the fifth shot, which fixed its F.M.* at 2.77. A sixth shot was fired in December, 1901, using a projectile fitted with a Johnson cap, weight 105 lbs. This shot was fired with a striking velocity of 1945 f.s., and the projectile completely perforated the plate and was found unbroken and in excellent condition. The F.M. of the plate was thus reduced by the action of the cap to less than 2.3, and the perforating power of the projectile was increased more than 20 per cent.

In May, 1902, a trial at the same range attracted considerable attention. In this trial 6-inch uncapped and capped projectiles were fired against an 11.8-inch Krupp Cemented plate. Uncapped projectiles fired with striking velocities as high as 2827 f.s. broke up on the face of the plate without perforating, while capped projectiles with striking velocities as low as 2799 f.s. completely perforated the plate without breaking up.

During the early experiments it was assumed that the cap was efficient only when the angle of impact was normal, or nearly so, and that at angles of incidence exceeding 30 degrees the cap was of no assistance. But from a series of shots fired at Redington, Pa., the proving ground of the Bethlehem Steel Company, in April, 1904, and at Sandy Hook in 1905, it appeared that the cap was efficient at all angles, and that the tendency of capped projectiles to "bite" at angles of incidence exceeding 45 degrees was marked, it being noted that all capped projectiles perforating the plate at such angles turned in toward the normal to an angle of about two-thirds the angle of incidence before perforating.

Most authorities now agree that the use of a cap against soft homogeneous plates will add nothing to the penetrative power of the projectile, and that there is a velocity below which the cap is useless, or nearly so. This velocity appears to be about 1800 f.s.

Since the introduction of the capped, forged, chrome-steel projectile, improvements in armor-piercing projectiles have been in the direction of material and methods rather than in design. Progress along these lines has enabled the forged steel projectile to hold its position with the best armor plate, the efficiency of modern, armor-piercing projectiles being now fully recognized as due as much to the excellent material employed, and the methods of manufacture, as to the efficiency of the cap. The above statement may be appreciated when more recent designs of armor-piercing projectiles are considered. The latest design, both in this country and abroad appears to be in the direction of a projectile body with an ogival head of from 2½ to 3 calibers radius, with a blunt point and provided with a thin cap or envelope, covering a large portion of the head, with a radius of about 7 calibers. The ballistic efficiency of the projectile is thus increased by reducing the co-efficient of form, *c*, about 50 per cent; and the blunt point, assisted more or less by the envelope, or cap, is depended upon for perforating hard-faced plates. In Figure 5 are shown two types of such projectiles, each designed to perforate a thickness of

---

* Ratio of thickness of plate to thickness of wrought-iron the projectile would have just perforated.

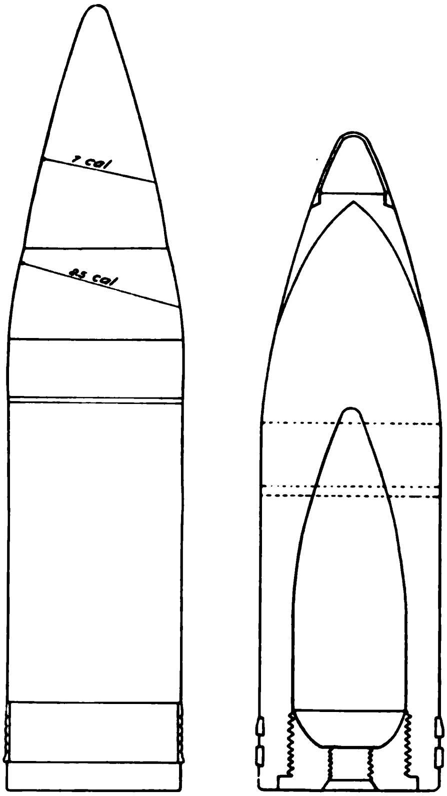


FIG. 5. - 1200

Modern A. P. projectiles,—
American and British types

hard-faced armor equal to the caliber of the projectile. Such projectiles, as manufactured abroad, carry a bursting charge equal to 3 to 4½ per cent of the projectile weight.

ARMOR ATTACK

The problem of armor attack has always been one of great complexity and is impossible of strict analytical investigation. When we consider the complicated and difficult treatment of large armor plates, and the secrecy preserved with regard to the processes and composition of materials, etc., it is evident that considerable diversity is to be expected in the results published from time to time. If in nothing else, this diversity would be clearly shown in the great number and variety of empirical formulas proposed for the perforation of armor. It is doubtful if it is possible to express the law of resistance of any armor plate and the power of any projectile to overcome that resistance by an exact formula, on account of the many conditions that escape calculation. Since the publication of Lieut. Weaver's articles, previously referred to, two important formulas have been brought forward. The first was proposed by Captain Tressider in the "Naval Annual" for 1905 and published in the JOURNAL, No. 1, Vol. XXVI.

The second formula was proposed by Major Alston Hamilton, U. S. Coast Artillery Corps, and published in the JOURNAL, No. 2, Vol. XXVII.

The practical coast artilleryman is chiefly concerned with the behavior of modern armor plates when attacked by service projectiles, under battle or service conditions; and, unfortunately, there is but a limited amount of data concerning tests of armor and projectiles under such conditions. Governments conducting tests of this nature very properly regard information obtained as confidential, and the publication of results is repressed or discouraged. Proving ground experiments were formerly made public; but recently, details of such experiments are generally withheld, and such data now available for publication is derived from results of acceptance tests of armor and projectiles. But, as is well known, conditions for acceptance tests are far from simulating battle or service conditions. The projectile arrives at the plate usually horizontal and with normal impact, while under battle conditions we should not expect more favorable angles than 35 degrees, measured from the normal. If, however, we accept the striking velocities allowed for acceptance tests of armor-piercing projectiles as the minimum velocities which will insure perforation by projectiles supplied under present specifications, we may determine the striking velocities the same projectiles will require under battle conditions and the corresponding ranges. This has been worked out in the following table, using Hamilton's method for oblique impact and the present test velocities as the basis. The corresponding ranges are correct only for the short nose projectiles. No range tables have been issued for the long nose projectile, therefore the corresponding ranges should be increased for such projectiles about 65 per cent.

Limiting Ranges for Perforation of K. C. Armor, 1 Cal. Thick.

Caliber in inches.	Weight in pounds.	Thickness in inches.	Striking velocity, normal impact, ft. per sec.	Range, normal impact, yards.	Striking velocity, battle conditions, ft. per sec.	Range, battle conditions, yards.
6 (2600)	106	6	2040	1357	2346	598
8 (2200)	316	8	1800	3096	2070	884
10 (2250)	604	10	1790	4210	2058	1700
12 (2250)	1046	12	1760	5389	2024	2433
14 (2150)	1660	14	1745	4550	2007	1400

ARMORED SHIPS

The evolution of the armored ship during the past twenty years may be brought out by a brief description of two battleships, the U. S. S. *San Marcos* (formerly *Texas*), launched in 1892, and the U. S. S. *Texas*, launched in 1912.

The *San Marcos* (old *Texas*) has recently been used as a target for experimental purposes, details of which appeared in the JOURNAL for July-August, 1911. The ship was stricken from the navy list on October 11, 1911.

The *San Marcos* (old *Texas*) was laid down at Norfolk, June, 1889, and was launched June 28, 1892. The design was purchased by the Navy Department from the Barrow Ship Building Company of England. The final trials of the ship were completed in December, 1895.

The *San Marcos* (old *Texas*) was 301 feet in length, 64 feet beam, 22 feet 6 inches draft, with a displacement of 6327 tons. The I. H. P. developed on trial was 8422, which compared favorably with the designed I. H. P. The designed speed was 17.8 knots; but this speed was never attained, and three years later, at Santiago, 13 knots was the best that could be attained.

The armor protection was essentially as follows: A waterline belt of the early Harvey type, 12 inches thick at the top and tapering to 7 inches at the bottom, extending 4 feet below and 3 feet above the waterline, protected the engine and boiler spaces for a length of 118 feet. This side armor was extended inboard diagonally at the ends to protect against a raking fire, the diagonal armor being 8 inches thick and 17 feet long. The protective deck, steel, 2 inches thick, rested on the armor belt and was 3 inches thick on the slopes at the bow and stern. On the lower deck above the protective deck, was an armored redoubt extending diagonally across the ship, the turrets being mounted at the ends, the port turret forward. The redoubt armor was 12 inches thick and of nickel-steel. The turrets were of 12-inch Harvey steel and the ammunition hoists to the turrets were protected by 6 inches of steel. The conning tower, located just forward of the smokepipe was of steel, 9 inches thick.

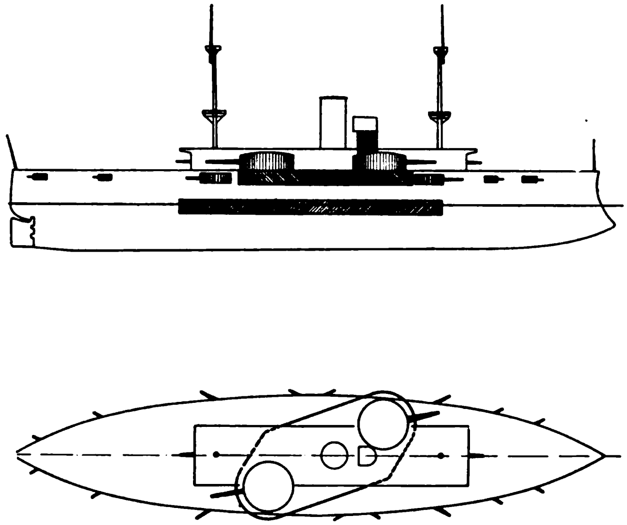


Fig. 6. 1201

U. S. S. San Marcos (old Texas), 1892

The general arrangement of the armament is shown in Figure 6, and consisted of:

Two 12-inch, 35-caliber guns, M.V. 2100 f.s.; one mounted in each turret.

Six 6-inch, 35-caliber guns, M.V. 2300 f.s.; distributed as shown, and unprotected by heavy armor.

Twelve 6-pounder guns.

Ten 1-pounder guns.

Two Gatling guns.

Two torpedo tubes, both above water.

The *Texas* was laid down at Newport News in 1911 and has been launched in 1912.

The *Texas* is 565 feet in length, 95 feet beam, about 24 feet draft, with a displacement of 27,000 tons. The designed speed is 21 knots. The *Texas* will carry the following armament:

Ten 14-inch, 45-caliber guns, M. V. 2600 f.s.

Twenty-one 5-inch, 50-caliber guns, M. V. 3000 f.s.

The 14-inch guns will be mounted in five elliptical turrets, located on the center line, two forward of the smokepipe and three abaft. One after and one forward turret will be elevated to allow four 14-inch guns to be trained dead ahead or dead astern. All of the ten 14-inch guns will be available for either broadside. The 5-inch guns for protection against torpedo attack will be distributed as shown in the plan.

The armor protection is essentially as follows, all of K. C. armor:

A main waterline belt 8 feet wide protects the engine and boiler spaces, extending for about 478 feet amidships. This belt is 12 inches thick at the top and 10 inches thick at the bottom, uniformly tapered for 418 feet, and 6 inches thick for about 60 feet.

An armored bulkhead, 10 to 11 inches thick, extends entirely across the ship at the forward end of the main belt, and a triangular bulkhead, 9 to 11 inches thick, extends entirely across the ship at the after end of the main belt.

The lower casemate armor, resting on the main belt, extends the limits of the magazine spaces. This armor is about 7 feet wide and is 9 inches thick at the top and 11 inches thick at the bottom, and is provided with transverse bulkheads, 10 inches thick, extending entirely across the ship.

The upper casemate armor, resting on the lower casemate armor, extends about 129 feet. This armor is about 4 feet

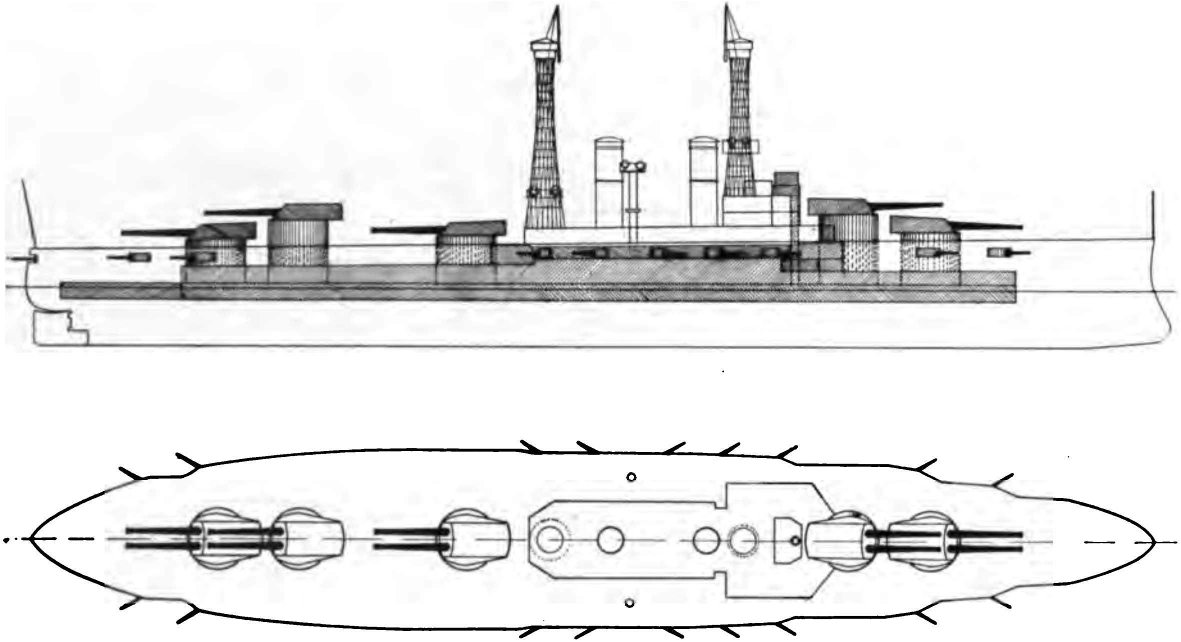


FIG. 7.

U. S. S. Texas, 1912

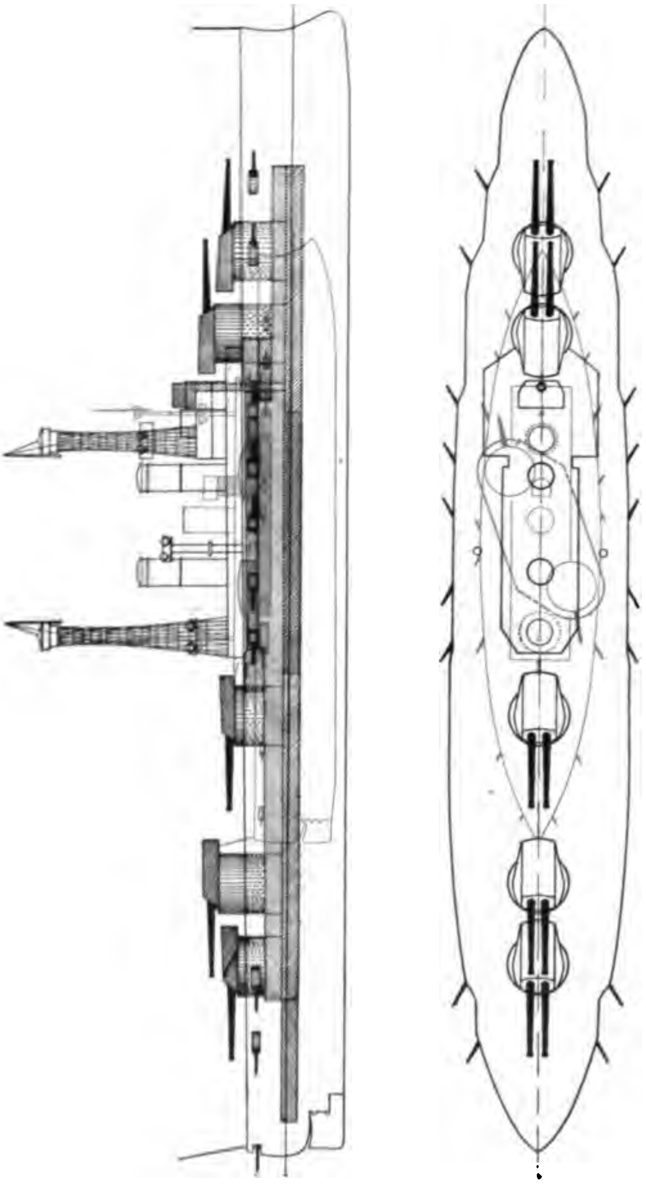


FIG. 8.
U. S. S. San Marcos (old Texas) and U. S. S. Texas

wide, and is 6½ inches thick throughout. Diagonal bulkheads, 6½ to 9 inches in thickness, extend across the ship to Nos. 2 and 5 barbettes, thus clearing the ends.

The 14-inch barbettes are from 4 to 14 inches thick. The 14-inch turrets have front plates 14 inches thick, sides and rears 8 inches thick, and tops 4 inches thick.

The central station is surrounded on three sides with armor 6 inches thick. The conning tower is 12 inches thick with a top 5 inches thick. The conning tower tube is 36 inches in inside diameter and is 11 inches thick.

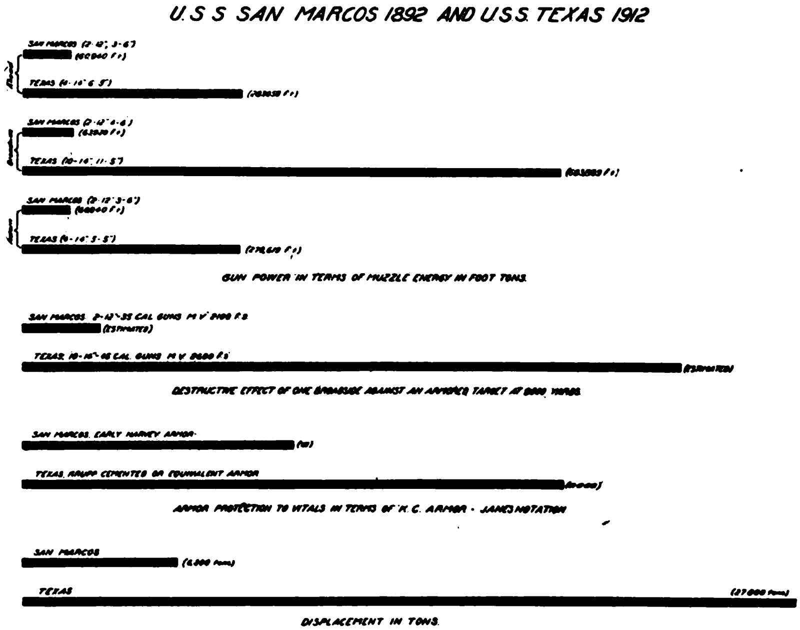


FIG. 9. 1203

Comparison of U. S. S. San Marcos (old Texas) and U. S. S. Texas

A comparison of gun power, protection, etc., of the *San Marcos* (old *Texas*) and *Texas* is shown by the graphic chart, Figure 9.

EFFECT OF RECENT NAVAL DEVELOPMENT ON COAST DEFENSE

In theory, fleets never attack coast fortifications; in practice they have almost invariably done so when the naval situation has admitted of it. Therefore, it is well to consider the effects of the present development of the big-gun-big-ship on defense. These may be briefly summed up as follows:

1. *Armament.*—The policy of most navies at the present time is to include in the assigned weight of battery the largest guns that can be readily handled, or to mount on all armored ships nothing but heavy guns (12 to 14 inches in caliber) in turrets, and an adequate secondary battery, 3 to 6 inches in caliber, for torpedo defense. This policy is necessary on account of the great thickness and extent of armor carried by modern armored ships, and because a gun below 12 inches in caliber will not do effective work against such armor at battle ranges. From a naval point of view this policy has the following distinct advantages:

a. Better protection for guns and personnel.
b. Fewer expert gun pointers required.
c. Better communications and easier fire control.
d. Simplified ammunition supply.
e. Increased accuracy of fire due to flatter trajectories.

The destructive effect of the old, 35-caliber, 12-inch guns of the *San Marcos* (old *Texas*) has been compared with that of the new, 45-caliber, 14-inch guns of the *Texas*. As this destructive effect is computed for an armored target, it is well to consider the effect of the 45-caliber, 14-inch gun, firing a 1400 lb. projectile against sand and concrete targets. Using the U. S. Engineer formula, we find that, at 9000 yards, 63 feet of sand or 21 feet of concrete will not stop the projectile. Therefore, if our coast guns are to be adequately protected, the parapets of batteries must be increased in thickness. In addition to the increased destructive effect of the heavy guns now being mounted on modern battleships, the adoption of improved mountings for such guns which admit of fire being carried on at ranges up to 18,000 yards, and improvements in naval gunnery which will make the fire of attacking ships effective at such ranges, are matters of great importance to the coast artillery. The accuracy of such guns is indicated by recent firings with the type 14-inch gun of the U. S. Navy.

For 15 rounds fired after 11 rounds had been previously fired, the following results were obtained:

Elevation, 8 degrees.
Angle of fall, 10 degrees.
Mean range, about 14,000 yards.
Average variation in range from mean range, 53 yards.
Average variation in velocity from mean velocity, 3 f.s.

It used to be held that guns on high sites were better protected than guns on low sites. This was mainly based on the proposition that mountings of guns on board ship would not permit of sufficient elevation at the then considered fighting ranges. But that this is a fallacy now, will be evident when we consider modern fighting ranges, the slight increase in elevation required to reach a site 1000 feet high, and modern methods of fire control by which a group of calibrated guns may be "spotted" up the face of a high site to the crest, where the batteries are usually located.

The increased range of guns now being mounted on modern battleships, give a fleet much more latitude as to positions from which a fortified place may be bombarded. In order to cope with guns of the attacking fleet under such conditions, the guns of coast forts must be of such a nature and so sited as to be able to fire on any position open to the fleet. With the limited range permitted by existing mounts, it is necessary that guns ashore be pushed well to the front. When however, as is often the case, this cannot be done, they should be supplanted by guns of greater power, or 12-inch mortars ranging up to 17,000 yards should be installed to cover the position.

The great displacement of modern battleships also means a corresponding increase in the number of rounds of ammunition carried by each ship. Thus, in the case of the *San Marcos* (old *Texas*), or taking one of the later ships of that period as an example, a fleet of 6 ships carried 24 heavy guns or 4 heavy guns each, with 60 rounds of ammunition per gun, or 1440 rounds for the fleet. A fleet of 6 ships of the *Texas* type carry 60 heavy guns, or 10 guns each, with 100 rounds of ammunition per gun, or 6000 rounds for the fleet. If we assume that in attacking a particular target it will require an expenditure of 1000 rounds, it is evident that upon the conclusion of the action, the fleet of 4-gun ships will have fired more than 40 rounds per gun and will have only 440 rounds on hand, while the fleet of 10-gun ships will have fired less than 17 rounds per gun and will have 5000 rounds on hand.

Assuming that the rates of fire are the same, without taking into account superior speed, it is evident also that the fleet of 10-gun ships will be under fire from the coast batteries about one-third the time of the fleet of 4-gun ships.

In addition to all of the above, the fleet of 10-gun ships will be at no disadvantage as regards the accuracy life of its guns, due to the limited number of rounds fired; so the probability of attack from such fleets is greater than it was from the old fleets of 4-gun ships, when the firing of a large number of rounds would impair the accuracy life of the guns and render the fleet incapable of resisting a hostile fleet on equal terms.

In actions between forts and ships, there has always been a disparity of armament. If the calibers and ballistics of the guns have been equal, superiority of numbers has usually been with the fleet. Therefore, if the use of coast guns in action is anticipated, it is important that the number of guns mounted ashore should not be too small in comparison with those that an enemy can bring to bear; and, if they are limited in number, as is usually the case, they should be of such power and so mounted as to make up in caliber and ballistics, the disparity in numbers.

Equality in striking velocity is not necessary, but equality or superiority in range is necessary.

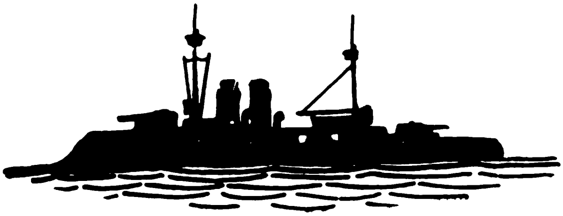
2. *Armor Protection.*—The great displacement of modern battleships also means increased protection to the guns, the personnel, and the vitals of the ship. The modern battleship of the big-gun type is so well protected, not only by armor but by watertight subdivision, that it is doubtful if a single impact on the waterline would seriously affect the trim of the ship. Taking the *Texas* as an example, we find that of the total displacement, nearly 7000 tons is devoted to armor. Of this, one-third may be assumed to be devoted to the protection of the guns and the personnel, and two-thirds to the hull for the preservation of buoyancy and stability and for the protection of the vitals of the ship. All heavy guns are mounted in turrets and protected by 14 inches of armor on the exposed sides. This protection is superior to any hitherto given to guns; and when we consider the thickness of waterline armor, with internal bulkhead construction, it may be frankly stated that the sinking of such a ship by long range fire of coast guns is entirely out of the question.

Actions between forts and ships will not be so decisive as actions between ships, as far as destruction of material is concerned; for, taking into account the peculiar functions of shore defenses, all that can be expected is so to cripple the attacking ships as to cause them to draw off, thus preventing them from accomplishing their object.

It should be remembered that an accurate and rapid fire has never failed to cripple vessels, however heavily armored, through damage to upper works, funnels, smoke-pipes, masts, and top-hamper.

The experiences of Tsushima show that perforation of belt and turret armor is not essential, and that frequent hitting by H. E. shell may be decisive. In the case of the *Texas*, the exposed area that is protected by armor 9 inches thick, or armor superior at battle ranges to any coast gun now mounted, is about 50 per cent of the total exposed area, which includes masts, funnels, etc.

The increased size of the target is an important advantage for the shore guns, the larger target increasing the chances of hitting. As a result of development, of naval actions of the Russo-Japanese war, and of recent tests conducted in this country and abroad, the old question of shell fire vs. armor perforation is still under discussion. It is probable that, as far as this country is concerned, the policy will be, as heretofore, to supply two types of armor-piercing projectiles: one designed to carry its bursting charge behind the heaviest armor before bursting, to be used at those ranges at which perforation may be expected; the other to carry a large bursting charge and designed to perforate armor about one-half caliber thick, to be used against personnel and matériel at those ranges at which perforation of the heaviest armor may not be expected. It is evident, referring to the table given on page 268 that projectiles of the first type should be supplied only to the most powerful guns; *i.e.*, 10, 12, and 14-inch; and that for such guns the proportion of the two types of projectiles should be not more than one of the first type to four of the other type.

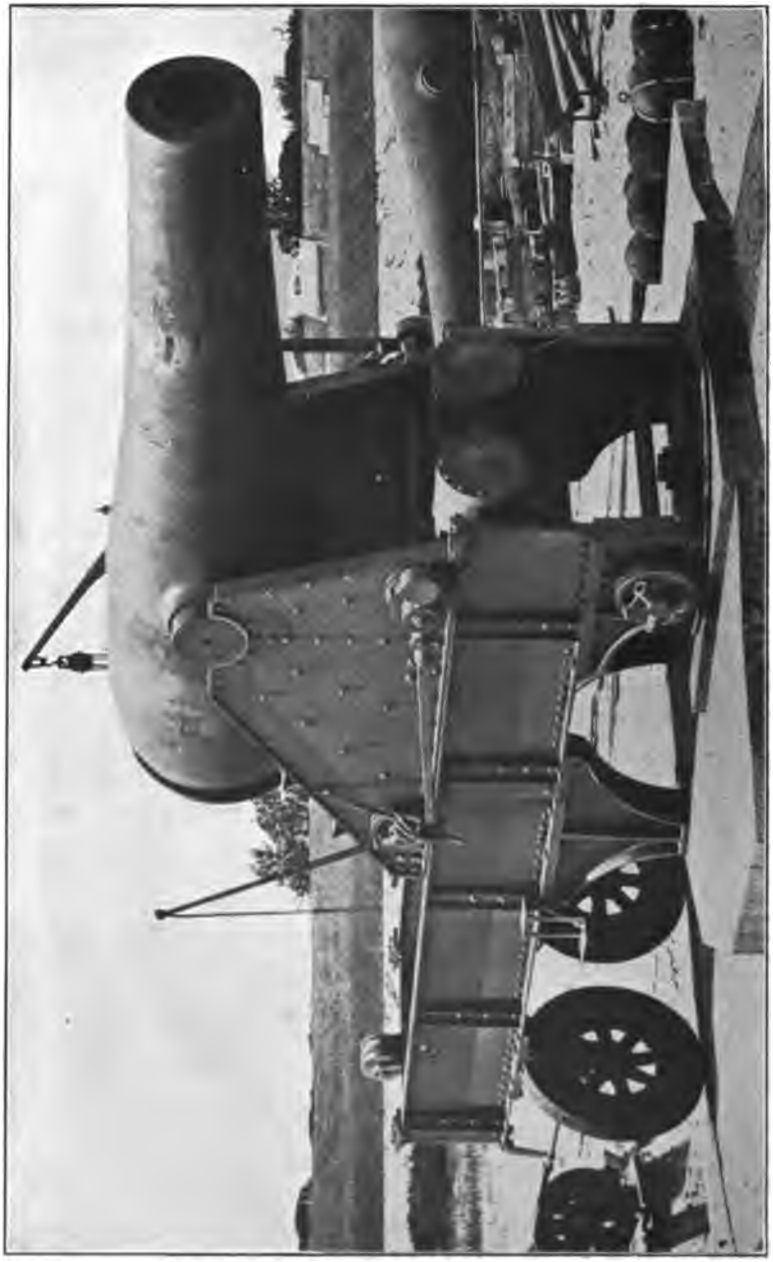


ADVANCE IN COAST ARTILLERY GUNS AND CARRIAGES FROM 1892 TO 1912

By Major JAMES M. WILLIAMS, Coast Artillery Corps

The twenty years from 1892 to 1912 practically include the whole of the development of modern coast artillery guns and carriages in the United States Army; for, while in our modern armament there still are found guns of model of 1888 and carriages of model of 1891, yet issue to the service is so much delayed after the design of models, and advance is so dependent upon use in service, that the period of development is really coincident with the twenty years between 1892 and 1912. And how near to even the earliest dawn of modern gun and carriage construction in the United States Army was the year 1892, appears from the report of the Chief of Ordnance for that year. In it is reference to the 1888 appropriation of $700,000 for the construction and the partial equipment of the north wing and the central section of the gun factory at Watervliet; and in it the Chief of Ordnance after stating, with some gratification, that "the Department was enabled to undertake the construction of two new types of barbette carriages, of 8 and 12-inch caliber, respectively, and to considerably facilitate the work on alteration of 10 and 15-inch S. B. carriages, which has been carried on * * * for several years past," projects a plan for an annual output of carriages which includes for the 12-inch gun no carriages of the disappearing type, but only those of the barbette, the gun-lift, and the casemate types; and which includes also fifteen carriages for the 15-inch smooth-bore gun and ten carriages for the 8-inch converted muzzle loading rifle.

Indeed, mention is made of the alteration of carriages for the 15-inch smooth-bore gun in reports of the Chief of Ordnance for the years up to and including 1897, in the report for which last year it is stated that the work of alteration of two such carriages, already begun at the commencement of the year, had been completed during that year.



1204

15-INCH MUZZLE LOADING SMOOTH BORE GUN ON BARBETTE CARRIAGE WITH PNEUMATIC BUFFERS; FRONT PINTLE

A type of gun and mount in use in 1892

But, if viewed from the point of vantage of the Chief of Ordnance, who from his mountain top could see the sun before it had really risen, the year 1892 was the dawn of modern artillery, from the point of view of the artilleryman in the valley that year was really in the darkness of the smooth-bore gun and boiler-iron carriage night.

The most efficient gun in use in the United States coast artillery in 1892 was the 8-inch muzzle loading rifle, which was the 10-inch cast iron, muzzle-loading, smooth bore gun converted into a rifle by re-boring up to a diameter of 13.5 inches and by lining with a rifled tube of coiled wrought-iron. The lining tube was itself really a "built-up" gun, for it consisted of two tubes, one shrunk upon the other. This gun fired an elongated, cast-iron projectile weighing 180 pounds; and with a charge of 35 pounds of hexagonal powder (black) gave an initial velocity of 1430 feet per second, accompanied by a pressure of 33,000 pounds per square inch. Elevated to ten degrees the gun had a range of 4723 yards, the time of flight being 13.26 seconds, the angle of fall 13° 26′, the remaining velocity 885 feet per second, and the drift 26.25 yards.

The carriages on which the 8-inch converted muzzle loading rifles were mounted, were altered barbette carriages of 10-inch smooth bore guns. In detail they were not all alike; but, in general, the cheeks of the top carriages were provided with rollers; the rollers in rear being on eccentric axles while those in front were on concentric axles. When the pieces were in battery, the front rollers were nearly in contact with the chassis rails; but those in rear were raised from the rails. To haul the pieces from battery, or to permit them to return to battery, the rear wheels were thrown in gear by means of the eccentrics. The lower front angles of the cheeks being truncated, when the carriages were tilted to the front by the operation of the rear eccentric axles, all rollers came into play and the pieces moved with comparative ease. In firing, the rear rollers were out of gear. To check recoil, the carriages were provided with hydraulic buffers.

Other evidence that the year 1892 was before the dawn of modern artillery, in so far as use by the artillery personnel was concerned, is found in the fact that "up to the beginning of 1894 no gun carriages for issue to fortifications had been completed, although nine 12-inch mortar carriages had been issued during the preceding year," and in the fact that the first target practice with the new armament was had during the year ending June 30, 1896.

And that it was just about dawn so far as development of modern coast artillery by the Ordnance Department is concerned, is further indicated by remarks of the Chief of Ordnance in his report for 1891. Referring to the Army Gun Factory at the Watervliet Arsenal, he states: "Enough of the machines for gun work has been installed to commence work." And referring to the Seacoast Gun Carriage Factory at the Watertown Arsenal, he states: "The labor involved and difficulties to be surmounted in supplying our fortifications with new model disappearing carriages for large guns is perhaps greater than that of supplying the guns themselves, and unfortunately this work is some years behind the guns. These difficulties are shown by the fact that foreign nations which have been expending large sums of money on this work for about twenty years have not yet arrived at a satisfactory disappearing carriage."

The type 8-inch rifle of model of 1888 was manufactured in 1890, as was also the type 10-inch; but the type 12-inch was not manufactured till 1891.

Prior to the manufacture of the type guns of 1888 model, there had been manufactured at the West Point Foundry (at Cold Spring, N. Y.), in 1886, one 8-inch B. L. steel rifled gun of "high power." But the type 8-inch gun of model of 1888 was the first piece of like caliber produced in this country entirely of American steel. Of the forgings for the 12-inch B. L. rifle, steel, No. 1 Type, the following were made at Le Creusot, France:

Tube,
Jacket,
Trunnion hoop,
A_1 hoop.

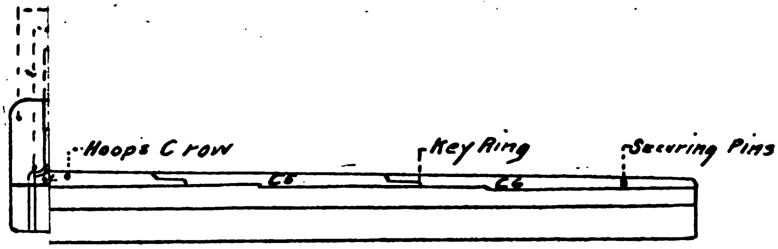
The remaining forgings were of American steel, manufactured by the Midvale Steel Company, Philadelphia, Pa.

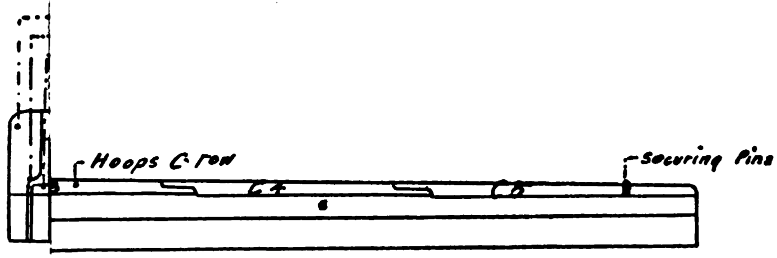
The advance of guns and carriages is obviously dependent upon the state of the allied art of metal working; and in the United States, because of the disinclination to obtain from abroad for Government use material that is superior to that made at home, the advance in guns and carriages is still further restricted by being limited to the state of the art of metal working in the United States. So, even as late as 1892, notwithstanding the previous adoption of type all steel guns, we find in the report of the Chief of Ordnance mentioned as experimental guns a "10-inch B. L. rifle, cast iron, hooped with steel wire," and a "12-inch B. L. rifle, cast, tubed with steel." And in his report for 1893 the Chief of Ordnance explains that the manufacture of the 12-inch, tubed, cast-iron gun and of the 12-inch, hooped and tubed, cast-iron gun had been recommended to Congress by the Department "at a time when the manufacture of reliable gun steel in large masses was in its infancy, and when the immediate establishment of a large steel plant in this country was not contemplated. The object of the Department was to develop a type of gun of greater power than the cast-iron smooth bores of the then existing seacoast armament. In order to utilize materials within its reach it was decided to make the bodies of those guns of cast-iron, taking advantage in this respect of the high quality of American gun iron." But changed conditions in the manufacture of domestic steel caused the Chief of Ordnance to recommend that the 12-inch cast-iron rifle be not adopted for service.

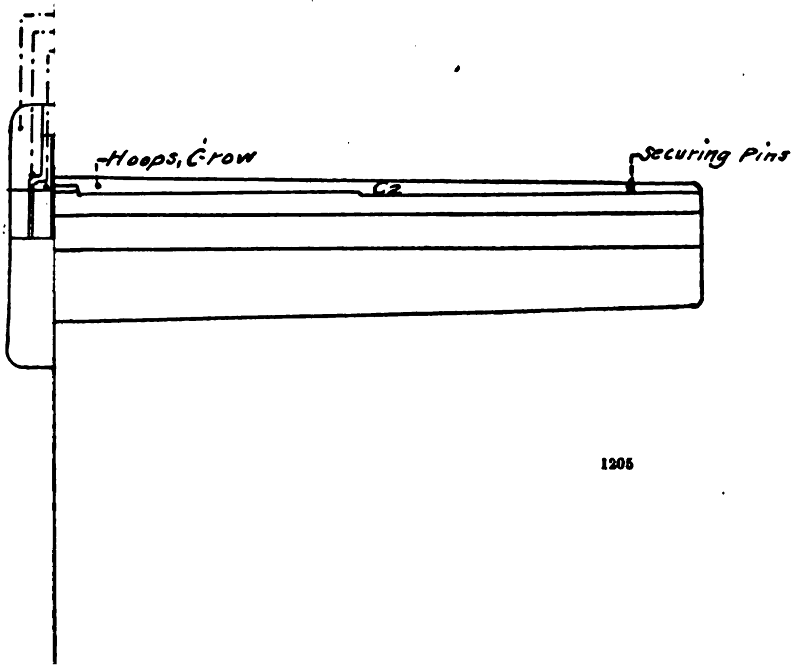
After the advance in steel-making in the United States had caused cast-iron to disappear as a gun material, still further progress in that art affected the development of gun construction. The Model 1888 8-inch rifle included, besides the tube and the jacket, 5 A-hoops, 6 C-hoops, and 2 D-hoops; while in the Model 1888MI the number of C-hoops was reduced to 5; and in the Model 1888MII the numbers of all hoops were reduced, there being only 4 A-hoops, 2 C-hoops, and 1 D-hoop. The length of gun in the three models was the same, 32 calibers.

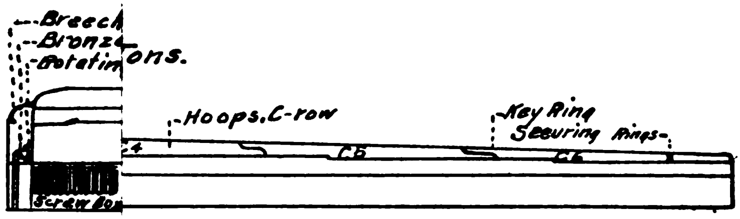
The continued reduction of the number of hoops as a result of improvement in steel manufacture is seen in the comparison of the 12-inch rifle of 1888 with the 12-inch rifle of 1900. The model 1888 12-inch rifle had the same number of A, C, and D-hoops as had the Model 1888 8-inch rifle, namely, 5, 6, and 2 respectively, and had 4 B-hoops in addition; but in the Model 1900 the numbers of hoops are reduced to the following: 2 A-hoops, 2 C-hoops, 1 D-hoop, and only 1 B-hoop; notwithstanding the fact that the gun of the 1888 model was of only 34 calibers length, while the gun of the 1900 model is of 40 calibers length. The original type 12-inch rifle which antedated the 1888 model, had had ten C-hoops.

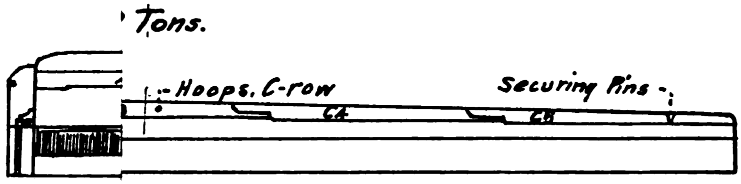
But not only has improvement in the manufacture and forging of steel led to simplicity in construction ,which results from a reduced number of hoops, but also has improved steel *ery, November-December, 1912.* Figures 1 and 2 to face page 282.

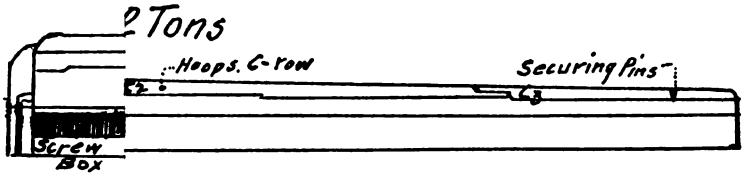


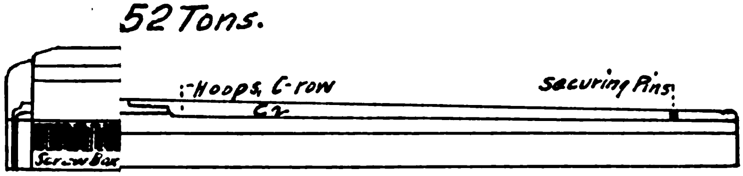


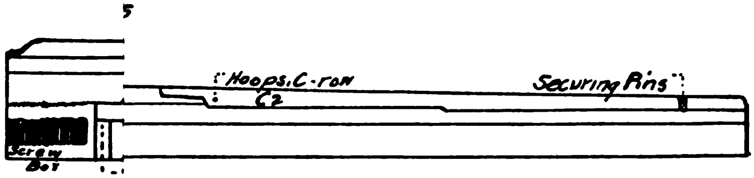


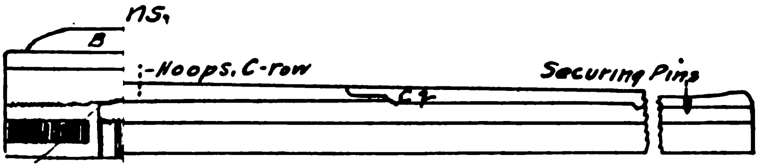

Breech
Bronz
Rotatin
ons.
Hoops, C-row
C4
C5
Key Ring
Securing Rings
C6
Screw Bo


Tons.
Hoops, C-row
C4
Securing Pins
C5


2 Tons
Hoops, C-row
C2
Securing Pins
C3
Screw
Box


52 Tons.
Hoops, C-row
C2
Securing Pins
Screw Box


5
Hoops, C-row
C2
Securing Pins
Screw
Box


ns.
B
Hoops, C-row
C4
Securing Pins

led to higher muzzle energy in the completed gun. For with better steel in the walls of the gun, permissible pressures are higher; and with increased length of gun, the projectile is longer subject to those pressures.

The improvement in steel during the twenty years has been due mainly to advances in manufacture and forging; for, in so far as composition is concerned, low-carbon steel was recognized as the better for gun construction at the beginning of the period; though it is a fact that in the table on page 24 of Chapter XV of his text book, "Ordnance and Gunnery, U. S. M. A.," published in 1891, Captain Henry Metcalfe, Ordnance Department, U. S. Army, does indicate "high" steel as the better cannon metal. However, from his discussion of the terms "high" and "low," as applied to steel, on page 17 of the same chapter, and from his indicating, in the table on page 18, "high" steel of from 0.35 to 0.50 per cent of carbon as applicable in the construction of cannon, it appears that he is in complete accord with the statement, "In gun steel the proportion of carbon is low, not exceeding 0.5 per cent as a rule," made on page 136 of "Ordnance and Gunnery," by Captain Lawrence L. Bruff, Ordnance Department, U. S. Army, published in 1902. The difference is in the definition of "high" steel at the two dates.

But while, as stated, the improvement in steel during the twenty years has been mainly, and for large caliber guns almost wholly, in manufacture and forging; yet for guns of small caliber great improvement in steel has been obtained by the addition of from 3 to 5% of nickel. By such addition it has been found possible materially to raise the elastic limit and tensile strength of steel without a corresponding reduction in ductility.

In his report for 1902 the Chief of Ordnance stated: "Owing to the higher qualities of nickel steel it is quite probable that this metal, now used for field and other guns of smaller calibers, where lightness is a consideration, will also be adopted for guns of large caliber;" but the change from the hooped to the wire-wrapped method of gun construction has since made such adoption unnecessary.

It is very interesting to note the different views that have been entertained during the twenty years on the subject of the caliber of guns, and the considerations which have led to the adoption of the 14-inch gun. In 1892 the Ordnance Department of the army had already adopted type guns of calibers of

8-inch, 10-inch, and 12-inch respectively; and prior to that year the Board on Fortifications or Other Defenses of 1886, appointed under the Act of Congress of March 3, 1885, had adopted forty-four 16-inch guns as part of our coast defenses, and had designated the harbors for the defense of which they were to be used. In his report for 1892 the Chief of Ordnance called attention to the fact that guns of 15¾ to 17¾-inch caliber were then included in the armaments of the principal foreign powers, and had been in use since 1882, and he stated: "Recent improvements in resisting power of ships' armor would seem to still further emphasize the already recognized necessity for guns of this caliber." But in Appendix 45 to the report of the Chief of Ordnance for 1893, Captain W. B. Gordon, Ordnance Department, stated that in the development of modern artillery "the tendency is [was] toward medium calibers and high velocities." Then in his report for 1895, in the course of a discussion of the necessity for 16-inch guns, the Chief of Ordnance introduces a foot-note to the following effect: "England has in her coast defense and navy sixteen guns of 16-inch and larger calibers and fifty-two of 13½-inch caliber. France has eight of 16½-inch, six of 14½-inch, and thirty-five of 13½-inch calibers. Italy has twenty-five of 17 and 17¾-inch and thirty-five of 13½-inch calibers. Denmark has 14-inch caliber guns. Our best information shows that Germany, Russia, and Spain have 14-inch, 14½-inch, and 15¾-inch guns in their coast defenses, but we have not information in regard to the numbers"; and he goes on to state: "This Department has never had any doubt of the necessity for the 16-inch gun, nor of the wisdom of its adoption by the Board on Fortifications or Other Defenses in 1886. Since the date of the report of that Board the history of Gun vs. Armor has steadily shown an increased necessity for a gun of as high power as that of the 16-inch caliber"; and: "It is deemed certain that they [guns of 16-inch caliber] will not only be wanted, but that they will become an imperative necessity." Then, after the lapse of about nine years we find this statement in "Gun Construction in the United States," by Captain Odus C. Horney, Ordnance Department, U. S. A., Paper No. 23 of Transactions American Society of Civil Engineers, International Engineering Congress, 1904: "It would be hazardous to predict that no larger guns than 12-inch, which is the largest caliber now built in the United States, will ever be used again; but it is safe to say that there will be no resort to larger calibers until the ultimate possibilities of the 12-inch gun have been much more nearly reached than at present." And at the very moment in which that was written we were, though it was not suspected, on the eve of revolutionary action in the matter of resort to larger calibers, because of the unexpected discovery that on account of the extremely limited life of the most recent model of 12-inch gun the ultimate possibilities of that caliber had then been reached, or reached, at least, when proceeding along the lines of advancement followed by the Ordnance Department of the army.

Preparing the way for an increase in the caliber of the highest power sea-coast gun, the Chief of Ordnance in his report for 1905 reviewed the history of gun construction as follows:

> "Since the beginning of gun construction the art has at various times encountered elements which for the time being have placed a limit upon its advance. For a long time the element was the strength of the guns to resist bursting, the powders in use being capable of developing higher pressures than the guns could be made to withstand, and the charges, therefore, being necessarily kept within small limits and giving correspondingly low velocities to comparatively light projectiles. There was gradual improvement in the methods of construction by the use of better materials, by improved methods of casting iron guns, by reinforcement with wrought-iron jackets, and finally by the introduction of the present high class of steel forgings and the system of building up of concentric cylinders under shrinkage. These advances were accompanied by improvements in the powder whereby its rate of burning was better controlled and larger charges were employed, which, giving off their gases more gradually, would sustain for a longer period the pressures which the guns would endure, and would thus continue the accelerating action upon the projectile. The improvement in powders naturally brought about both the carrying forward toward the muzzle of the strong section of the gun and the lengthening of it so as to hold the projectile longer subject to the accelerating forces. These advances brought about a temporary check in regard to the projectiles, perhaps more feared than realized, these being apparently unable to withstand the impact produced by their high velocities against first-class armor. But such improvement of them was speedily made as to remove this limit upon the power of guns.
>
> "Accompanying the use of the larger charges of powder there was introduced a new element limiting the life of guns, namely, that of erosion of the bore. This was very great in the neighborhood of the seat of the projectile, and very decided in its action, scoring and guttering the surface in a manner which required its renewal after a certain number of rounds. The life fixed by this process, however, was not unreasonably short, a 10-inch gun being capable of enduring from 250 to 300 rounds before requiring relining, so that the question of limiting the power because of this difficulty was scarcely considered. With the general use of smokeless powder, however, with its still better control of the rate of burning, and the great increase in the powder charges and in the velocity, the subject of the wear of the bore has greatly increased in importance. This wear is of a different kind from

that described above, being unaccompanied by the deep guttering of the surface which was experienced with the powder immediately preceding, but the smooth and even wearing away of the surface proceeds with such rapidity that after some 50 or 60 rounds from large guns the rifling is so worn away that the projectiles are no longer given the motion of rotation necessary to steadiness of flight, and inadmissible loss of accuracy results. There has therefore, been brought about a serious consideration of the question whether the guns should not be used at a power less than that which their strength enables the realization of in order to diminish the erosion and increase the life.

"It must be remembered that in thus using the guns at less power the energy of the projectile is reduced by a sacrifice of that quality which it loses soonest in flight in any event, namely, the velocity; and it must also be remembered that it is quite possible to retain the superiority of the gun over anything which it is called upon to attack by using larger calibers for given work and by building guns of larger size than is now customary, experimental constructions, as well as theory and natural fore-sight, having shown that the present conventional maximum need by no means be accepted as a limit. These questions are receiving serious consideration in order to make wise selection among courses which are open."

And in his report for 1906, directly discussing erosion as affecting the proposed substitution of a 14-inch for the 12-inch gun, the Chief of Ordnance said:

"* * * * considering the 12-inch gun of the model of 1900 * * * , we have for the life of this gun, firing a projectile of 1,000 pounds weight with a velocity of about 2500 feet per second only about 60 rounds. As the gun is capable of firing for a considerable interval at the rate of 45 rounds per hour, it is seen that the limit of its life could be reached in less than an hour and a half. * * * By lowering the velocity of the 12-inch projectile to 2250 feet per second the life of the gun is increased to 200 rounds, * * * The penetration of armor plate is, of course, reduced by this process, that of the 12-inch gun at 10,000 yards coming down from about 10½ inches to about 9 inches and the range at which its projectile would penetrate 12 inches of armor plate being reduced from about 8000 yards to about 6000 yards, Krupp hard-faced armor being referred to in both cases. * * * The design of a 14-inch gun has been laid down in this office of which the weight is 49½ tons (111,000 pounds), the weight of the projectile is 1660 pounds, and such construction has been adopted as will involve a muzzle velocity of 2150 feet per second. The charge of powder required to produce this velocity is about 280 pounds, as against 366 pounds for the 12-inch gun of the model of 1900. By reason of the lower velocity required and the consequent smaller powder charge, it is possible to make the 14-inch gun proportionally shorter than the 12-inch gun, and the smaller charge of powder also involves a less diameter of powder chamber and therefore, with the same thickness of wall of the chamber in calibers, a less exterior diameter of the gun over the breech. These elements of saving are so considerable that the weight of the 14-inch gun becomes actually less than that of the 12-inch, and as a lower maximum pressure is needed it is possible to attain all the strength which will be used without
the most expensive steel. The muzzle energy of the 14-inch pro-
e about 15% greater than that of the 12-inch, and because both

of its lower velocity and its greater weight the retarding influence of the air will be much less upon this projectile, so that the gain of energy will be in greater proportion with each increment of range. The life of the gun before its accuracy should show impairment will be about 240 rounds, corresponding to about six and one-half hours of continuous firing at the rate at which it is thought that it can be fired. Because both of its lighter weight and of the cheaper material of construction, the cost of the gun will be less than that of the 12-inch gun, while the cost of the charge of powder will be also less than that for the 12-inch gun by about $70. * * * Summarizing, it appears that by using in the situations requiring the greatest power a 14-inch gun, with 2150 feet per second muzzle velocity of projectile, instead of the 12-inch gun, with 2500 feet per second initial velocity, we should secure a lighter gun, a cheaper gun, a heavier projectile, greater muzzle energy, a still greater proportion of energy at each distance beyond the muzzle, and a life four times as long."

Of the 14-inch gun there are already four models: the 1907 W. A., which is of the wire-wrapped type and of which one gun has been constructed; the 1907 MI, W. A., of the hooped type, of which four guns either have been or are being constructed; the 1909 W. A., of the wire type, of which four guns are being constructed; and the model of 1910, of the wire type.

Not unnaturally, we do not find in each of those models all the points of difference enumerated by the Chief of Ordnance in his comparison of the 14-inch gun with the 12-inch gun in 1906. For instance, the 1909 model 14-inch gun is heavier than the 1900 model 12-inch gun, the former weighing 62.1 tons, while the latter weighs but 59.1 tons; and both the 1909 and the 1910 models 14-inch gun are of the same proportional length as the 1900 model 12-inch gun, namely, 40 calibers. This increase in length of 14-inch guns has been made practicable by the determination to mount them in turrets, instead of, as originally intended, in emplacements, in which they were to be interchangeable with 12-inch guns; and the gain in ballistic effect resulting therefrom, as indicated in the Table of United States Army Cannon, revised May 10, 1910, is 2220 feet per second muzzle velocity instead of 2150; range of maximum elevation 17,788 yards instead of 16,949; 18.1 inches penetration of Krupp cemented armor at 5,000 yards range instead of 17.2 inches penetration; and 11,300 yards limiting range for penetration of 12-inch Krupp armor with impact at 35° to the normal, instead of 10,200 yards.

In the design of all models of the 14-inch gun departure has been made from the rule long established in our service of having a number of rifling grooves equal to six times the caliber in inches, the number of grooves in those models being 126, or nine times the caliber in inches.

At present the capacity of powder chamber of all models of the 14-inch gun is 13,526 cubic inches, as compared with the 16,514 cubic inches of the 1900 model of the 12-inch rifle; but, chiefly on account of the difficulty that has been experienced in loading the type 14-inch gun, it has been decided to enlarge the chamber capacity of all models to 15,000 cubic inches; and it is expected that that enlargement will result in establishing a muzzle velocity of 2250 feet per second.

Even more radical than the change from the 12-inch gun of high velocity to the 14-inch gun of comparatively low velocity, has been the recent preferment by the Ordnance Department of the wire-wrapped type of built-up gun to the cylindrical, or hooped, type.

For a great number of years it was the policy of the army Ordnance Department to construct only the hooped type for issue to the service, though it was experimenting with three patterns of wire guns, the Woodbridge, the Brown-segmental, and the Crozier pattern. But in referring to a 14-inch gun in his report for 1910, the Chief of Ordnance stated: "This gun is of the wire-wrapped type, a method of construction which is being extended to all seacoast cannon of 6-inch caliber and over." And, since the date of that report, decision has been made to extend the application of the method still further, to include all guns and mortars above 3-inch caliber.

In addition to the advantage of a reduction in cost, which is said to be about 20 per cent, the wire-wrapped gun, as compared with the cylindrical, or hooped, type of built-up gun, has the advantage of eliminating the danger from concealed defects in forgings for hoops.

Another innovation of gun manufacture recently adopted by the Ordnance Department, is providing all seacoast guns of 6-inch caliber and over, not including mortars, with double tubes. The object of that is to reduce the waste occasioned by thermal, or heat, cracks, it being expected that a crack developing in a gun so lined will be confined to the inner tube. Such cracks are due to the high temperature of the powder gases; and to the cracks and to the brittle condition of the metal of the surface of the bore which accompanies them, the Ordnance Department attaches so much importance as to be of the opinion that all guns in which they are pronounced should be relined, without waiting for the accuracy life of the guns to be destroyed by erosion and wear. And providing guns with double tubes not only will limit the depth to which the brittle condition and thermal cracks can extend, but also will facilitate and reduce the cost of relining. In the recent relining of a 6-inch gun so equipped the inner tube was dropped from the gun merely by running a stream of cold water through the bore after the entire system had been heated to a reasonable degree.

It is expected that by confining to an inner tube a crack developing during an engagement, the gun can be successfully used to the end of the engagement.

In the 1910 model of the 14-inch wire-wrapped gun, the inner tube at a point in front of the powder chamber, but in rear of the trunnions, is about 2.5 inches thick, tapering to about 1.2 inches at the muzzle; while the second tube is, at the same point, 2.67 inches, tapering to something less than 2 inches at the muzzle. The wire wrapping varies from about 4¼ inches to about 1⅛ inches. The outer covering consists of a jacket of about five and a half inches thickness over the powder chamber and about three and a half over the bore in rear of the trunnions; a tapering D-hoop; and three tapering C-hoops.

The four step rings, forming the front connection between the jacket and the tube, which constitute a characteristic feature of the Crozier pattern of wire-wrapped gun, are present in the 1910 model 14-inch gun. The use of the step-rings leaves the wire wrapping practically continuous, and, at the same time, obviates the necessity of transmitting longitudinal stresses through any portion of the wire wrapping.

Besides the advances that have taken place during the twenty years in large caliber guns themselves, many improvements have been made in attachments. For instance, prior to about 1895 the obturator did not include the split rings, which are now such an essential feature; but had in their stead front and rear cups, against the lips of which the pads were very frequently cut. However, as is well known, notwithstanding the introduction of the split rings in the obturator, the gas-check pads employed in the past, consisting of a composition of asbestos and tallow, have not proved entirely satisfactory; because, especially in rapid fire, due to the action of heat, powder gases, etc., certain objectionable chemical and physical changes would take place in the composition that would still cause the pads to stick and to be cut. That trouble is now being overcome to a very great extent in guns already constructed by substituting for the tallow in the composition a non-fluid oil; and will be overcome to even a greater extent in new guns by reducing the mass of the pad.

Then there are numerous other improved details, such as the clamping arrangement of the obturator spindle; the continuous motion mechanism for opening and closing the breech; the safety firing mechanism; the automatic locking device; etc.

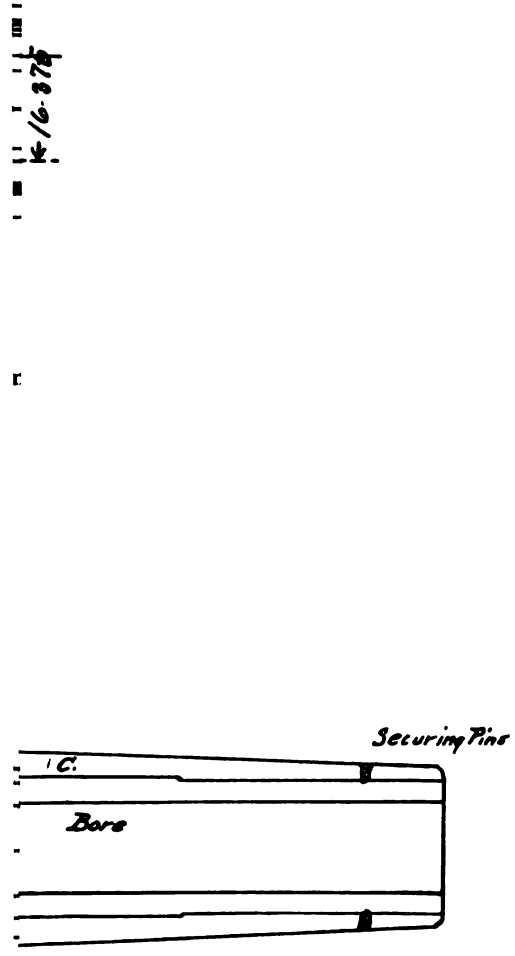
In rapid fire guns the advance has been even greater than in guns of large caliber; for in 1892 there were no rapid fire guns whatever included in the coast defenses of the United States.

In the report of the Chief of Ordnance for 1895 mention is made of six-pounder and 4.7-inch guns as having been experimented with and found suitable; and in the report for 1897 are mentioned as being considered a 3-inch 16-pounder gun, two types of 5-inch gun, one built-up and the other a solid single forging, and a 6-inch gun. But it was not until precipitated by the war with Spain that the supply of rapid fire guns was actually begun, contracts being let and emergency purchase orders being given at that time for a total of 243 guns of various calibers, namely, 6-pounder, 15-pounder, 4.7-inch, 5-inch, and 6-inch. Still, on June 30, 1898, there were mounted only five rapid fire guns, namely, four 4-inch Driggs-Schroeder on pedestal mounts, and one 5-inch on pillar mount.

Now our coast defenses include three models of 6-pounder guns; three models of 15-pounders; one model of 4-inch gun, of which there are but four guns, however; three models of 4.72-inch, varying from 40 to 50 calibers in length; two models of 5-inch; and eight models of 6-inch, the latest model of the 6-inch being a wire-wrapped, dóuble tube gun of 2600 feet per second muzzle velocity, capable of penetrating seven inches of Krupp armor at 1170 yards range with impact at 35° to the normal, and at 5000 yards range capable of penetrating 2.8 inches of Krupp armor.

In the power of the 12-inch seacoast mortar itself no advance has been made since 1892, the all steel model having been designed at that time; but in our appreciation of what the mortar is capable of as now mounted there has been wonderful advance. Originally, it was intended for use against fixed targets only; and in his report for 1892 the Chief of Ordnance estimates the rate of fire of the mortar "to be at least one shot in eleven and one-half minutes;" whereas now it is successfully

290.



1288

13 Tons

employed in practice against moving targets, and can be fired at a rate of one minute interval between shots from the same mortar.

However, in the different models of the original mortar reduction in the number of hoops is observed as in the case of guns, and in the method of construction of the mortar change has recently been made in harmony with advance in the construction of guns. The mortars of latest model not only are wire-wrapped, but also have breech mechanisms similar to those of the later seacoast guns. They will have the same interior ballistics as the old steel mortars; but by reason of the wire-wrapping they will weigh about 30% less than the old mortars and will cost considerably less.

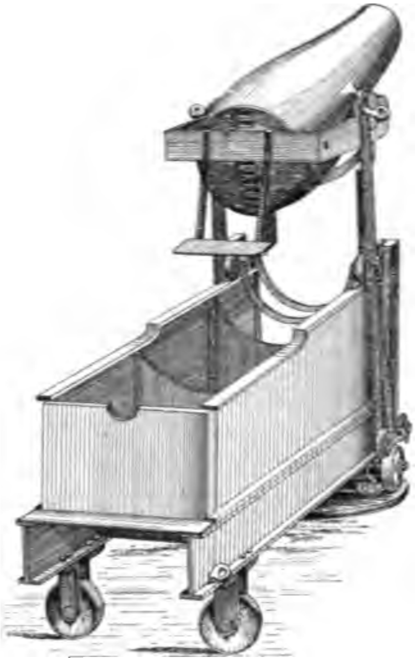
CARRIAGES

In 1892 no carriages for modern guns or mortars had been issued to the service. In fact, at that time the only type carriages adopted were the 8-inch and 12-inch barbette carriages and the 1891 model of mortar carriage; but the type barbette carriages had not then been manufactured, and so, of course, had not been subjected to test.

The disappearing, or as it was early called, depressing gun carriage was just being evolved into practicability. After referring to experimental firing from a 10-inch pneumatic disappearing carriage, the Chief of Ordnance in his report for 1892 states: "The work on the two other types of disappearing carriage which the Department has under manufacture is progressing. The Gordon 10-inch carriage is nearly completed, and the 8-inch and 10-inch carriages on the Buffington-Crozier plan will be completed during the coming winter or early spring."

That experimenting with disappearing carriages was pursuant to the adoption of the principle of the disappearing mount by the Board on Fortifications or Other Defenses in 1886, when no practical mount of that kind had yet been constructed.

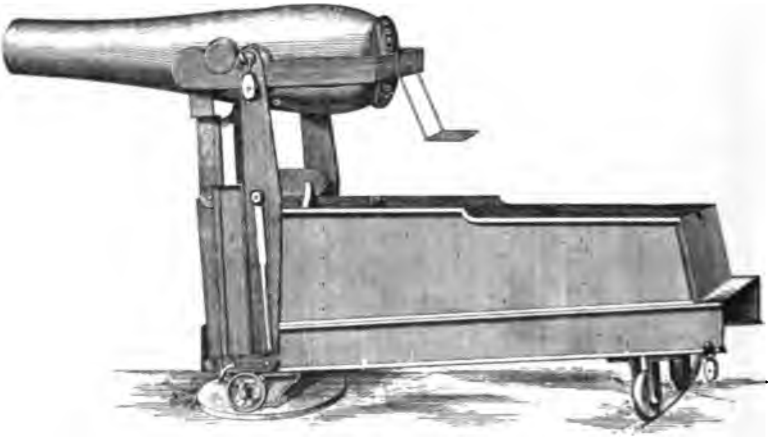
In 1872 Captain A. R. Buffington, Ordnance Department, U. S. A., had "presented a design for a form of carriage embodying the essential movements of the carriage afterward adopted." But it was not until about 1890 that Captain William Crozier, Ordnance Department, U. S. A., acting under the incentive of the necessity created by the formal adoption



1209

BUFFINGTON'S COUNTERPOISE GUN CARRIAGE

View in position for firing (rear)



1210

BUFFINGTON'S COUNTERPOISE GUN CARRIAGE

View in position for firing (side)

of the principle, made the design a practical success by working out its details and, especially, by adding the hydraulic recoil cylinders.

The manufacture of disappearing carriages for issue to the service commenced in 1893; but subsequent alterations in the design caused the carriages first issued to be known as the model 1894. And it being considered at that time impracticable to mount upon disappearing carriages guns of the size and power of the 12-inch rifle, the 1894 model was for 8-inch and 10-inch rifles only.

The 1894 model was a "front-pintle" carriage with exposed traversing wheels; recoil rollers on axles; and very imperfect control of the movement of the gun into battery.

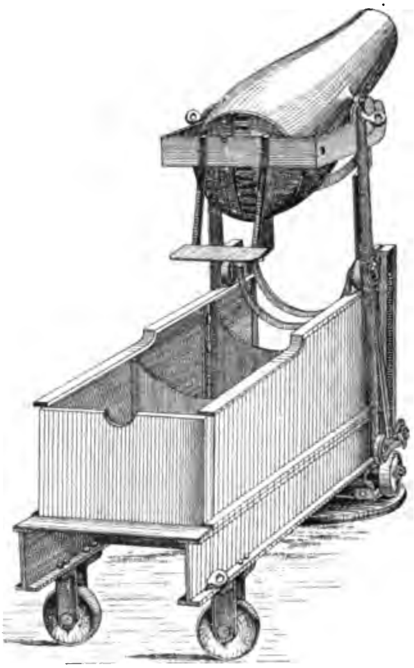
In the 1896 model a single turn-table with all the traversing mechanism enclosed was substituted for the forward turntable and exposed rear wheels and traverse-circle; and live chassis rollers supplanted the axle rollers.

While there have been many other improvements in details of the disappearing carriage, such, for instance, as the means of relieving the elevating mechanism of thrust when firing, the means of equalizing the forces required for elevating and depressing, the means of oiling the main bearings, the graduation of range disks in yards, the application of electric power for retracting, the provision of slow-motion mechanisms for traversing, elevating, and depressing; yet it is in the hydraulic recoil system that the most characteristic improvements have been made, and hence in it that the general advance of the carriage can best be followed.

In the 1894 model the recoil was controlled by the passage of liquid from the front to the rear of the pistons through slots in them, constant resistance in the cylinders being maintained by varying the orifices of flow by means of throttling bars of sectional areas calculated to give the desired resistance at each position of the piston during recoil.

The "counter-recoil," or movement of the gun into battery, was controlled very imperfectly by means of annular projections on the front faces of the rear stuffing-boxes and corresponding recesses in the pistons, the liquid caught in the recesses escaping only through small clearances. But that counter-recoil buffer was found very irregular in its action; so steps were taken to provide a more satisfactory buffer.

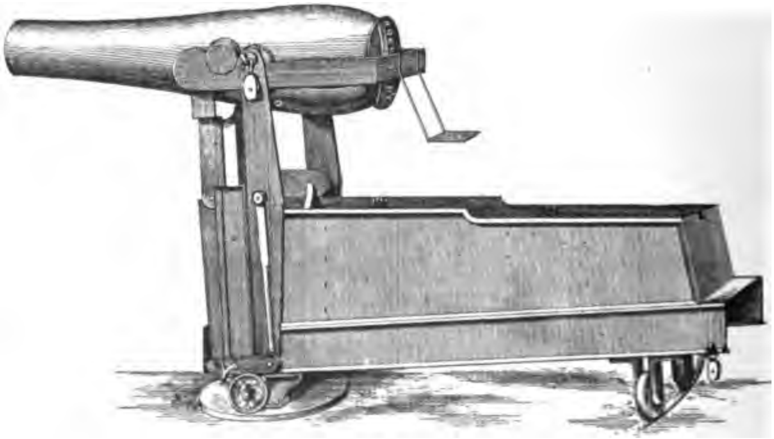
The next counter-recoil buffers consisted of bronze cylinders screwed, and later cast, on the rear cylinder heads, into



1209

Buffington's Counterpoise Gun Carriage

View in position for firing (rear)



1210

Buffington's Counterpoise Gun Carriage

View in position for firing (side)

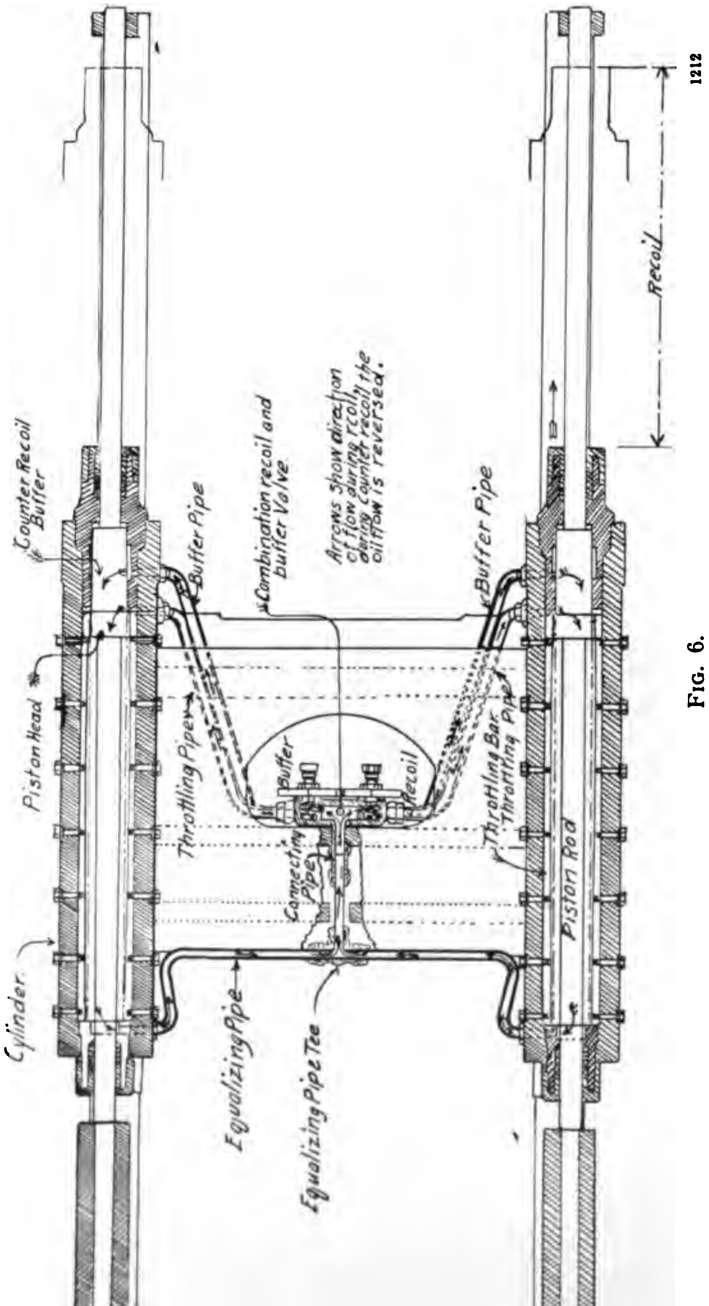


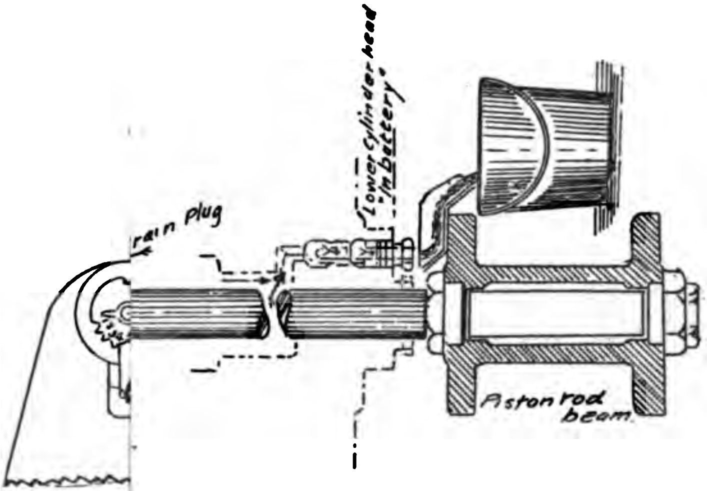
FIG. 6.

Hydraulic recoil system with valves for regulating pressure both in recoil and in counter-recoil carriages, which was made to increase rapidity of fire through a reduction in the time of return to battery, aggravated that imperfect control. So it was not long before an escape for the oil from the counter-recoil buffer cavities was afforded by means of a second pipe connecting the rear ends of the cylinders; and regulation of the flow of oil from the buffer cavities was effected through a buffer valve at the connection of the second rear pipe with the longitudinal connecting pipe, which formed a part of the passage for the flow of oil from the buffer cavities to the front of the pistons in counter-recoil as well as a part of the passage of the flow from front to rear in recoil. Thus, direct means of regulating the counter-recoil as well as the recoil was afforded by means of a valve; in consequence of which, the necessity for small lead hand-weights as an adjustable element of the counterweight for the purpose of regulating counter-recoil, was removed.

However, though the means were direct in each case, yet they were not separate, and a change in the setting of the counter-recoil buffer valve affected the flow of oil in recoil. Nor could the regulation of recoil and counter-recoil be made separate so long as the checking of both was effected through the same hydraulic system. So that and other considerations led to a desire wholly to separate the functions of controlling recoil and counter-recoil by providing a separate system for each.

The other considerations leading to a desire for separate systems were: First, when both recoil and counter-recoil are controlled by the same horizontal cylinders, the extremely high pressure that would otherwise result at the beginning of recoil, when the enlargements of the piston rods which form part of the counter-recoil device emerge from their recesses in the rear cylinder heads, prevents filling with oil the entire cublical contents of the cylinders; and that is objectionable, on account of the rusting of the surfaces of those portions of the interior walls of the cylinders and of the piston rods not covered by oil. Second, in the latter part of the movement in recoil of a disappearing gun, the gun is moving almost vertically downward; consequently, the horizontal movement of the top-carriage to the rear is very slight; and since it is in the last part of the recoil that complete control of the movement of the gun is most desirable, in order that the gun may be brought to rest at any desired position for loading, and without shock to the carriage, there is little opportunity for horizontal cylinders attached to the top-carriage to control effec-

November-December, 1912. **To face page 296.**



1213

tively the movement of the gun in recoil. On the other hand, in the latter part of the movement in counter-recoil, that is of the gun into battery, the gun having already risen above the parapet, is moving forward into battery; so it is then that the top-carriage has its most rapid motion. Hence, horizontal cylinders, while not adapted for controlling the movement in recoil, do afford effective means for controlling the movement of the gun in counter-recoil. And since it is at the end of recoil that the counterweight has its most rapid motion, a vertical cylinder attached to the counterweight may be made most effective in controlling the movement of the gun in recoil.

Consequently, in separating the systems, a very radical departure from former practice was made in providing for the control of the recoil a single veritcal hydraulic cylinder moving with the counterweight; and for the control of the counter-recoil, two horizontal hydraulic buffers fitted to the forward ends of the chassis roller paths.

The new vertical recoil cylinder differs from the old horizontal cylinders in some very radical features. In the first place, the old throttling bars are supplanted by throttling grooves cut in the interior of the cylinder. As were the bars, the grooves are diametrically opposite and are of varying cross-section, in order that the resistance opposed to the energy of recoil of the gun and top-carriage may be constant. The piston rod is bored axially to receive the stem and body of the recoil valve, the action of which is, in general, as follows: at the piston head the axial bore is surrounded by two grooves, from each of which radiate four holes, and one set of four holes opens into the cylinder on each side of the piston. Oil can, therefore, pass from one side of the piston to the other in two ways, namely, by the outside of the piston head through the diametral clearance and the throttling grooves, and by the two sets of radial holes. But the passage by the two sets of radial holes is regulated by the recoil valve body, which is a bar fitting closely in the piston rod bore and having a diametral slot, which, when the valve is entirely open extends from one groove to the other. As the valve body is drawn upward, the portion of the slot in the valve body open to the lower groove in the piston rod bore diminishes, so that at the end of its upward movement the passage between the two sets of radial holes is closed.

The new counter-recoil buffers, mounted one on each chassis rail in front of the top-carriage, consist essentially of

U of M

two short cylinders; pistons that are without apertures for the passage of oil from one side to the other; piston rods that are attached to buffer spring rods; sets of springs to force the piston rods nine inches to the rear when the gun is out of battery; and pipes connecting, through an adjustable valve, the interior of each cylinder on the two sides of its piston and also the interiors of the two cylinders. The buffers are wholly detached from the top-carriage, which comes into contact with them only as it goes into battery, when it strikes the projecting ends of the piston rods, forces them to the front, and compresses the springs.

It is to be noted that, even though the systems for the control of recoil and counter-recoil have been separated, a system being provided for each, still they are not wholly independent; for the setting of the recoil valve slightly affects the control of counter-recoil; however, the adjustment of the counter-recoil buffers has no effect whatever upon the control of the recoil, which is more important.

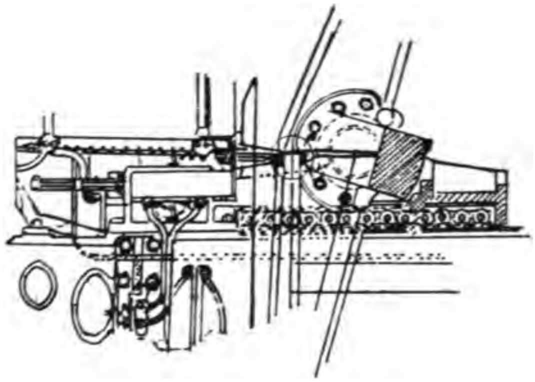
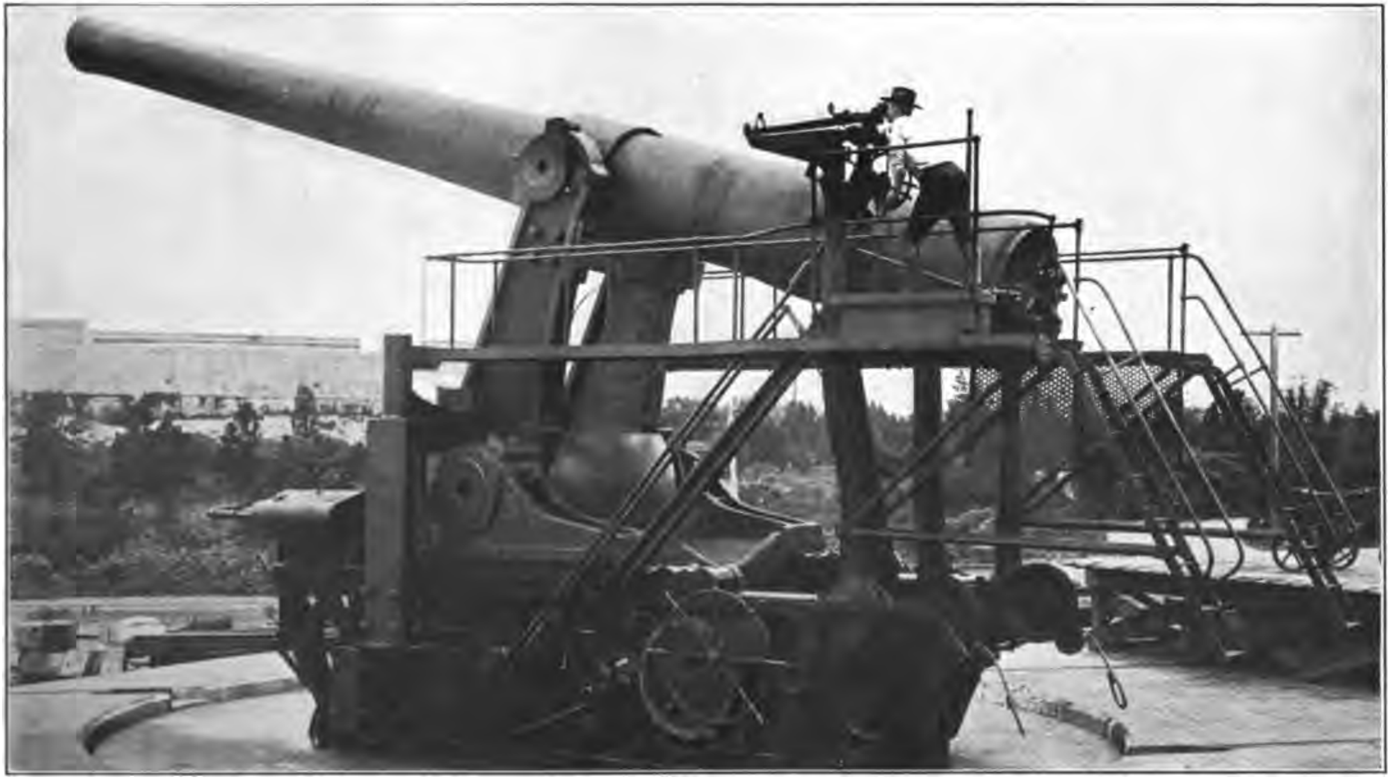


FIG. 8. 1214

Hydraulic counter-recoil buffer separate from the recoil cylinder

The hydraulic systems described were introduced with the 1905 model of carriage for the 6-inch gun, and are included in the designs of the carriages for the 14-inch guns.

Another feature of the late model carriage is the elimination of the wire-rope from the retraction mechanism, retraction being accomplished through trains of gearing on each side of the carriage which transmit the power from the shaft on which are the cranks to pinions engaging in racks on the guides.



14-Inch Wire Wrapped Gun (Breech Loading), on Disappearing Carriage, Model 1907 1215

This type of gun and mount is the latest of its class in 1912

For the 14-inch gun, besides the improved model of disappearing carriage, there is being constructed a land turret mount.

The provision of the turret is an entirely new departure in our service, and it is to be of limited application. Two are being constructed, both being double-turrets for the accommodation of two 14-inch guns each. They are the largest and most heavily armored structures of their kind ever manufactured.

The guns to be mounted in the turrets will be provided with gas ejecting devices similar to those in use aboard our naval vessels; and there will also be employed for hoisting ammunition and for ramming projectiles means similar to those employed on battleships.

Of mounts for rapid-fire guns the twenty years have included the total development; for, as already noted, at the beginning of the twenty years there were no rapid fire guns included in our coast defenses.

In this class of mount there is great variety, and a study of the development of each pattern would be profitable and interesting, but would scarcely fall within the scope of this article. Suffice it to mention a few of the rather general improvements, such as: arrangements for simultaneous but separate pointing in range and direction; provision of gearing for moving in azimuth carriages originally equipped with shoulder-bar movement only; development of form and thickness of shields; etc.

For the 6-inch rapid-fire gun there is being manufactured a barbette carriage designed for use behind armor, instead of behind concrete emplacements.

The advance from the original 1891 model of carriage for the 12-inch mortar has been phenomenal. Beginning with the substitution of coiled springs for the original Bellville springs in the 1891, model; through the adoption of the Gordon, or 1896, model; and through the repeated strengthening of that model, on up to the present modified carriage, with grooves substituted for the original throttling holes of the recoil system, with a brake added to prevent accidental rotation of the racer, with improved counter-recoil buffers, and with attached quadrants, the progress has been steady.

And there is now a new model mortar carriage which permits fire at angles down to 0° of elevation, and in which the mortar is so mounted that it may be brought rapidly to the loading position without movement of the cradle, and there-

fore without disturbing the laying, which may proceed during loading. This latter feature will undoubtedly increase the rapidity of aimed fire; but it is questionable whether advantage will be taken of the feature of the new carriage which permits direct fire.

NOTE

In the preparation of this article, in addition to reports of the Chief of Ordnance and various Ordnance Department pamphlets, reference has been made to the following publications:

Manual of Heavy Artillery, etc., Tidball, 1898;

Ordnance and Gunnery, U. S. M. A., Metcalfe, 1891;

Ordnance and Gunnery, Bruff, 1902;

Gun Construction in the United States, by Odus C. Horney, Captain, Ordnance Department, U. S. A., Paper No. 23 in Transactions American Society of Civil Engineers, International Engineering Congress, 1904;

Seacoast Gun-Carriage Design and Construction, by Edward P. O'Hern, Captain, Ordnance Department, U. S. A., Paper No. 24, in the same.

A SCHEME FOR THE TRAINING OF A COMPANY OF COAST ARTILLERY FOR FIELD WORK IN CONNECTION WITH THE LAND DEFENSE OF SEA COAST FORTIFICATIONS*

By Captain JOHN G. WORKIZER, Coast Artillery Corps

This training involves something more than mere instruction in drill regulations. It consists of making an infantry company out of a coast artillery company. To do this one must not only change the material and methods of instruction, but, in many cases, the entire habit of mind of the members of the organization.

My company is, I believe, a good average company of coast artillery. It is now, and has been for years, in the upper half in efficiency rating as shown by target practice records, one year being rated first. Like most other companies it has a number of men who have served in other branches of the service, principally infantry. Last winter we were ordered to Texas and while *en route* I was asked what I thought of my company as infantry. I replied that I thought it was as good as or better than any company I had ever served with. I found out my mistake immediately on arrival in Galveston. Of course, I expected that the company would be green in the matter of unloading, making camp, etc., as I have seen good infantry forget everything they knew about such things after a few months in garrison. I did not find out just what was the matter, and I admit a degree of uncertainty now; and that uncertainty will continue until I have seen a test of this scheme.

The coast artillery soldier in his post duties and at the guns has to do with permanent material under conditions which vary only slightly. Practically every move is pre-arranged. At all times he is under the close supervision of his officers. Except in the cases of a few non-commissioned officers and selected privates, the demands on his initiative are few. If anything unexpected happens, he reports and waits for orders. As a rule, his individual duties require more education and intelligence than do those of the infantryman, but their very nature tends to destroy his initiative. In close and extended order drills, marching, camping, and general discipline, he is as well instructed and efficient as any, but he is lost when he leaves the beaten path. Therefore, in addition to instruction in the various duties of infantry in the field, great effort must be expended in the development of self reliance and aggressiveness. In other words, initiative.

---

* Furnished for publication through the courtesy of the War College Division, General Staff.

Climate and regulations give us in this district* four months indoors and eight months outdoors. The indoor period is devoted principally to indoor gymnastic drills and theoretical instruction in gunnery and kindred subjects. I have been drilled or have drilled others for the past twenty-seven years in indoor gymnastics and I have never seen any beneficial military result that could not have been obtained in some way more hygienic and interesting. We waste time making the natural gymnast more expert and never do the naturally awkward man any good. Five or ten minutes lively exercise in the open—in any weather—will do all that can be done for the latter class. The others will enjoy the short drill, and valuable time and energy will not be wasted. During the past winter we have had a brisk marching exercise each drill day with excellent results. Now that we have in most companies of the coast artillery a majority of gunners, and have competent instructors developed among the non-commissioned officers, the time devoted to artillery instruction is too long. For men who have only to requalify, two months is ample. The few non-gunners can be left out of the scheme to be outlined below and placed in charge of an instructor. The instructor can be changed as a different subject is taken up and will have lost only a small part of the instruction given to the company. Men desiring to qualify for ratings will do it without instruction.

I would devote the first two months of the season to theoretical and practical training in infantry work. To be specific:

INDOOR SEASON

December.—In this district practical work can be given at least two-thirds of the time.

---

* Artillery District of Baltimore.

Company extended order, 4 days per week,

- 1st week: 1 hour drills.
- 2nd and 3rd weeks: 3 hour drills. During this period particular attention is given to the subject of "Fire."
- 4th week: 1 hour drills. During this period there will probably be some bad weather and lectures should be given on Part II, Infantry Drill Regulations.

There may be bad days in the early part of the month. The first that occurs should be used for a black-board talk on patrols. (Field Service Regulations.)

January.—All fair days should be used for practical instruction in patrolling and outpost duty. These periods should be 3 or 4 hours. The first bad day should be devoted to instruction in reading the best topographical map obtainable of the vicinity of the post. These latter periods should not exceed an hour and a half.

- 1st week: Map reading.
- 2nd week: Field Service Regulations. Lectures.
- 3rd week: Lectures on fire control.
- 4th week: Tactics. Map problems in patrolling and outpost duty.

I never tried the experiment of giving lectures to enlisted men until this winter. My first was on the subject of map reading, and the interest it aroused caused me to continue the experiment and to extend it to other subjects, such as "patrols," "outposts," "ammunition supply," "organization," etc. My procedure is to give a black-board talk on the subject, say for fifteen or twenty minutes, and then to ask questions at random of the men. I encourage them to ask questions, and take particular pains to see that the answer is fully understood. In this connection I would lay stress on the necessity of overcoming the diffidence of the men, and avoiding anything that bears the remotest appearance of levity or sarcasm in the answers. Some, and in fact many, of the questions are very foolish, and it is frequently very difficult to believe in the good faith of the men asking them; but in order to get any results, the instructor must be on good terms with the class. Most enlisted men are poor students and have great difficulty in getting anything out of a book; but a short talk on a new subject, especially one which broadens their view of their own duties, is of great benefit. Incidentally, the lecturer broadens his own view. The lectures on Field Service Regulations should also include that part of the Infantry Drill Regulations which applies.

The map problems in patrolling and outpost duty given in the last week should be solved by the instructor and followed on the map by each man. Of course, the problem will have to be of the simplest nature. After the solution has been explained by the instructor, there should be a general discussion and one of the men required to repeat the solution; *i.e.*, to conduct a conference on it.

February and March.—Artillery instruction for non-gunners.

For gunners,

1st two weeks: Map reading. Problems.
2nd two weeks: Topography. Map reading.
Remainder of the time: Map problems. Tactics. Map reading.

Of course, many of the qualified men will by this time have advanced as far in the work as is possible for them. The men should be assigned to classes according to their aptitude. No difficulty is experienced in the first two weeks, but thereafter the question of instructors becomes a serious one. So far, in following this schedule, one officer has been able to handle it. Officers of all companies should be detailed as instructors, each to take a subject for which he is especially suited. The men assigned to the three subjects named above, from all the companies, should report to the same instructor. When a man qualifies in map reading he should be sent to the class in topography. The instruction in topography should cover the use of the instruments provided by the Engineers, and practice in sketching with and without these instruments.

By the first of March most of the men will have a fair working knowledge of map reading, and the instruction in tactics may be extended to giving a situation and requiring individual solutions. One or two of the best of these and one or two of the worst should be made the subject of a lecture, the points of excellence and the defects being pointed out. Every opportunity should be taken to enunciate and emphasize the tactical principles involved. Constant repetition of such principles as are practically axiomatic is necessary.

Map reading and topography are given considerable prominence in the above schedule. I believe that one of the best qualities that a soldier can possess is "ground sense."

If it is not born in him or acquired through hunting or the practice of some such vocation before he entered the service, the only practical method for peace times is a thorough course in these two subjects. This "ground sense" is an absolute necessity for a good patrol leader. The course in tactics is devoted almost entirely to patrolling and outpost duty. The former subject I consider the most important, because if we can develop good patrol leaders, they are sure to be good men for outpost duty, and, in fact, for any independent duty that might fall to an enlisted man.

I have allotted but one week to "Fire,"except such incidental instruction as is given during the 2nd and 3rd weeks of December. I believe that the subject is covered as far as it is advisable to go in theory during this time; because it is so comprehensive, involving, as it does, everything from the mechanical operation of loading to the instantaneous estimate of a situation that may be very complicated. As there are no absolute rules, I believe that the time allotted is sufficient to impress the men with the importance of the subject and to teach them to look to their platoon commander for the solution.

The months of April to July, inclusive, are crowded with other instruction, the infantry work being simply disciplinary. August brings service practice and about two weeks of living in tents. It is doubtful if there will be opportunity to do much infantry work during this period.

September is devoted entirely to infantry exercises. It is assumed that two or three weeks of this time will be devoted to tactical exercises of the battalion and to the solution of a problem involving the troops of the home district and those of some other district. There will be much opportunity during these exercises to bring out and impress the principles of fire control, and to practice on new ground under varying conditions the principles learned during the company instruction. October is devoted to post work, and to the drills and instruction preliminary to target practice with small arms.

November brings the range firing. I believe that Special Course "A" is ample instruction in known distance firing for any troops. Perhaps some firing at 500 yards would increase the good results, but Course "A" brings such efficiency as is needed. Men learn to aim, hold, and pull- -all that the best troops in the world can do in action. I once saw a member of the Army Infantry Team miss a steer, standing, at fifty yards. I should like to see some field firing added for the coast artillery.

During the period of combined exercises, the men should be informed of the various situations assumed and should be given a general outline of the solution proposed. On the completion of the problem, they should also hear what the umpires have to say about it. A company officer could communicate this in a few minutes, and I know that the time used would be well expended. Every detail is unnecessary, but such information should be given as will arouse interest and rivalry. I have been to a number of maneuver camps, but I never knew what was going on until I was detailed as an umpire. There is, however, no reason why a problem should not be interesting to everybody in the command. It is not necessary that the private be familiar with the general situation, but he should know what his company, and sometimes even his battalion or regiment, is to do. When I was a second lieutenant of infantry, I received instructions one day from my captain to take the first platoon and "come with me." He took me about half a mile through the woods to a cross-roads and left me. I had no other instructions. I had observed the captain in whispered conversation with the major just after the major had been listening to the colonel, and figured out that I was some part of an outpost. Gen. Coppinger and his staff happened along in a few minutes after the captain had left me without leaving an address, and asked me a number of questions. There were tears in his voice when he bade me "good-morning."

During the combined exercises there will be plenty of opportunities for instruction in camping, marching, and intrenching, and by the best means—experience. Errors made will impress themselves through increased discomfort, etc., and will, with timely advice, correct themselves.

This paper does not adhere strictly to the title assigned, because I believe that there is no material difference in the methods to be pursued, whatever the work is to be. I have entirely omitted all defensive work, because, except for the patrolling and outpost work which are otherwise provided for in the schedule, there is nothing required of enlisted men. The instruction in map reading, topography, and tactics, as outlined, will give the men a thorough knowledge of the country in the vicinity of the post, and thus equip them for the land defense. I should like to see some night work in patrolling and outposts, but the regular garrison duties demand so much time that I am unable to recommend any plan. I have tried to use the time actually available, employing methods which

NOTES ON INTERIOR BALLISTICS

By Colonel JAMES M. INGALLS, United States Army (Retired)

205 Governor Street,
Providence, R. I., September 14, 1912.

The Editor,
Journal U. S. Artillery,
Fort Monroe, Virginia.

Dear Sir:—

I send herewith a few random notes relating to the third edition of my "Interior Ballistics", recently published by John Wiley and Sons, which I think will interest those who have purchased a copy of the work, all of whom are presumably readers of the Journal.

Very respectfully,
James M. Ingalls,
Colonel, U. S. A., Retired.

Notes

1. Equations (33) and (36), pages 114 and 115, are correct for cordite and analogous grains for which α is approximately 2 and $\lambda - \frac{1}{2}$; but for single perforated grains where α is in the neighborhood of unity and λ very small (but not small enough to be dropped out entirely), these equations need modification. For these grains the maximum pressure occurs when $x = 0.6$ (instead of 0.45 as for cordite), and the numerical coefficients in (33) and (36) are changed as follows: In the expression for c, page 114, 7.68507 becomes 7.69238. In (33), 3.051 is changed to 3.5066 and 0.48444 to 0.54488. In (36) substitute 9.15409 for 9.21453, and 2.85250 for 2.79937.

2. Recently, in making some calculations pertaining to the Deport 75 mm. mountain gun, which has a very small powder chamber, I found that my table of the X functions was

not extended far enough for a complete discussion. I have, therefore, continued the table for X_0, X_1 and X_2 (which are the only ones required) as far as $x = 50$.

Table of logarithms of the functions X_0, X_1 *and* X_2 *from* $x = 25$ *to* $x = 50$.

x	log X_0	D	log X_1	D	log X_2	D
25	1.02735	557	0.84851	833	9.82116	275
26	1.03292	536	0.85684	797	9.82391	261
27	1.03828	516	0.86481	763	9.82652	247
28	1.04344	498	0.87244	732	9.82899	235
29	1.04842	480	0.87976	703	9.83134	223
30	1.05322	463	0.88679	676	9.83357	212
31	1.05785	448	0.89355	651	9.83569	203
32	1.06233	434	0.90006	628	9.83772	195
33	1.06667	421	0.90634	607	9.83967	186
34	1.07088	407	0.91241	586	9.84153	179
35	1.07495	395	0.91827	567	9.84332	172
36	1.07890	384	0.92394	549	9.84504	165
37	1.08274	374	0.92943	532	9.84669	158
38	1.08648	364	0.93475	516	9.84827	152
39	1.09012	354	0.93991	501	9.84979	147
40	1.09366	345	0.94492	487	9.85126	141
41	1.09711	336	0.94979	473	9.85267	137
42	1.10047	328	0.95452	460	9.85404	132
43	1.10375	321	0.95912	448	9 85536	128
44	1.10696	313	0.96360	437	9 85664	124
45	1.11009	306	0.96797	426	9.85788	120
46	1.11315	299	0.97223	415	9.85908	116
47	1.11614	292	0.97638	405	9.86024	113
48	1.11906	286	0.98043	396	9.86137	110
49	1.12192	280	0.98439	386	9.86247	106
50	1.12472	274	0.98825	377	9.86353	103

3. *Errata in third edition of Ingalls' "Interior Ballistics,"*—

Page 2, in line 12, *for* "objection" *read* "objections."

Page 11, first paragraph, *for the statement* "This is also very nearly the composition of the powder used in the United States Army and Navy" *read* "The powder used in the United

States Army and Navy is pure soluble nitrocellulose with a stabilizer of diphenylamine."

Page 82, remove the first radical sign from the denominator of equation (9).

Page 114, equation (33) should read

$$N = \frac{1 - c}{X_0\left(1 - \frac{[0.48444]\, c}{X_0}\right)}$$

Page 114, in line 11, *for* "logarithmitic," *read* "logarithmic."

Page 118, equation (36′), the logarithmic factor within the braces should be [2.79937].

Page 119, *for* "$\bar{x} = 16.018$" *read* "$\bar{x} = 16.0018$."

Page 119, *for* "$u = 42.30$ ft.", *read* "$\bar{u} = 42.26$ ft."

Page 119, *for* "$v = 3261$ f.s." *read* "$\bar{v} = 3253$ f.s."

Page 148, *for* "$\lambda = -1$" *read* "$\lambda = -\frac{1}{2}$."

Page 168, in line 7 from bottom, make $\tilde{\omega} = 323$ lbs.

Page 189, *for* $x = 0.35$, log X_2 should be 8.97861; and for $x = 0.42$, log X_3 should be 8.85313.

1. 1 10-inch columbiad in barbette, in "covered way."
   Manned by a detachment.
2. 1 10-inch columbiad in barbette.
   1 42-pounder, rifled gun.
   7 32-pounders.
   1 42-pounder, rifled gun, in casemates.
   2 8-inch columbiads in casemates.
   Manned by Company "A," 1st Artillery.
3. 1 10-inch columbiad in barbette.
   5 32-pounders in barbette.
   1 42-pounder, rifled gun.
   1 8-inch columbiad in casemate.
   2 42-pounders (S.B.), in casemates.
   Manned by Company "L," 1st Artillery.
4. 1 10-inch columbiad in barbette.
   3 42-pounders, rifled guns, in casemate.
   Manned by Company "K," 2nd Artillery.
5. 1 10-inch columbiad in barbette.
   1 42-pounder in barbette.
   2 8-inch columbiads in casemates.
   Manned by Company "E," 3rd Infantry.
6. 1 10-inch columbiad in barbette.
   2 42-pounders, rifled, in casemates.
   1 8-inch columbiad in casemate.
   Manned by Company "C," 3rd Infantry.
7. Mortar battery in ditch, curtain A and B.
   4 10-inch seacoast mortars.
   Manned by a detachment.

Besides these there were the following field works:

Battery Scott,
    2 10-inch columbiads, barbette.
    1 42-pounder, barbette.
    2 10-inch sea coast mortars.
    Manned by Company "F," 1st Artillery.

Battery Lincoln,
    4 8-inch sea coast howitzers, in barbette.
    1 42-pounder, in barbette.
    2 10-inch sea coast mortars.
    Manned by Company "H," 2nd Artillery.

Battery Totten,
    1 13-inch sea coast mortar.
    1 12-inch sea coast mortar.
    Manned by Company "C," 2nd Artillery.

Battery Cameron,
- 2 10-inch columbiads in barbette.
- (1 10-pounder Parrott, rifled gun, added second day.)

Battery at Old Spanish Fort,
- (1 10-pounder Parrott gun; 1st day.)

Or recapitulating, there were in Fort Pickens:
- 34 casemate guns.
- 103 barbette guns.
- 28 flanking howitzers. (See plate 5 of the Atlas accompanying the "Official Records of the Union and Confederate Armies.")

Including the guns of the fort and of the batteries outside the fort, there were:
- 10 10-inch columbiads.
- 6 8-inch columbiads.
- 11 42-pounders.
- 2 42-pounders, smooth bore guns.
- 4 8-inch sea coast howitzers.
- 8 10-inch sea coast mortars.
- 1 13-inch sea coast mortar.
- 1 12-inch sea coast mortar.
- 12 32-pounders in barbette.

The Navy had there:
- *Richmond*, 16 guns.
- *Niagara*, 12 guns.

CONFEDERATE

Fort Barrancas, a permanent work on the mainland opposite Fort McRee and Fort Pickens, had:
- 33 barbette guns,
- 8 flanking howitzers.

Fort McRee, a strong masonry work opposite Fort Pickens, had:
- 80 casemate guns (2 tier casemates),
- 53 barbette guns.

Redoubt of Fort Barrancas, an advanced work on the land side of the fort which did not bear on the water, had:
- 8 barbette guns,
- 8 flanking howitzers,

and further strong defensive arrangements. It required approaches to reduce it.

There were also many other batteries, of which the armament is not definitely known. In all, the Confederates had two forts and fourteen separate batteries that contained from 1 to 4 guns each, some 10-inch and 12-inch columbiads, and some 13-inch sea coast mortars.

The strength of the garrisons is not known; probably, though, it was in excess of 1500 men. All were under the command of General Bragg.

NARRATIVE OF EVENTS

The bombardment was opened by the Federal forces of Fort Pickens at about 10 a.m., October 22, 1861; and about half an hour later the Confederates replied from their numerous batteries about Pensacola Bay, their batteries extending from the Navy Yard to Fort McRee, a distance of about four miles, and all nearly equidistant from Fort Pickens, the ranges only varying from 2100 to 2900 yards.

The two ships belonging to the Navy, because of the shallow water, had to lie about two miles out from Fort McRee, which was too far for them to get the full effect of their guns. However, they kept up a spirited fire on the forts and the adjacent batteries all day.

The fire from Fort Pickens was continuous till dark at a rate of a shot for each gun every fifteen or twenty minutes.

The fire of the forts in the possession of the confederates, was somewhat slower.

By noon the guns of Fort McRee were silenced, with the exception of one; and three hours before sunset the fort and the adjoining battery ceased firing entirely.

Batteries Lincoln, Cameron, and Totten were directed on the batteries adjacent to the Navy Yard; Battery Scott, on Fort McRee and the Light House Batteries; and those of the fort, on all.

The fire of Fort Barrancas was materially reduced, and that of the batteries in the vicinity of the Navy Yard and one or two others, entirely silenced.

The efficiency of the fire of Fort Pickens at the close of day was not in the least impaired.

The Confederates' rate of fire was somewhat slower.

The next morning fire was reopened at about the same hour. The ships, on account of wind, were not able this day to get in even as close as before; so their fire was not so effectual.

Fire at Fort Pickens was slower and was believed to be more effective.

Fort McRee, silenced the first day, did not fire on the second day.

At Fort Pickens there were one or two guns silenced and one gun disabled by a shot coming through an embrasure.

By projectiles from Fort Pickens fire was started in the town adjoining the Navy Yard, and the Navy Yard was burned. The buildings were further badly damaged by shot and shell.

Firing was again continued till dark and the mortars kept up their fire till 2 a.m. the next morning, when the combat ceased.

Fort Pickens was often hit, but, outside of loss of one gun-carriage and a small loss amongst the personnel, was just as efficient as when the bombardment began.

Losses at Fort Pickens would have been heavy but for the elaborate protective measures taken.

The destruction of the Navy Yard as contemplated was not accomplished, and the result of the bombardment may be regarded as indecisive.

The rate of fire on the second day on Fort Pickens, was:

10-inch columbiads, a shell every 15 minutes;
42-pounders, rifled guns, same rate.
Mortars, every half hour.

The fire on the second day was very effective, silencing for several hours various batteries. The flag staff at Fort McRee and the one at Fort Barrancas were shot away.

CASUALTIES

Fort Pickens,—
1 man killed,
7 men wounded.
U. S. S. Richmond,—
1 man killed,
7 men wounded.
Confederate Loss,—
6 men killed,
21 men wounded.

The *Niagara* and the *Richmond* were both struck twice.

General Bragg in his report stated that the Federals were said to have fired some 5000 rounds and the Confederates 1000 rounds.

There was also another bombardment, January 1, 1862. It was caused by a small steamer's entering the Navy Yard and being fired on by the Federal batteries. The fire was returned; and though only about four shots were fired on each side at that time, yet about three quarters of an hour later the Confederates began a regular bombardment, which was responded to by the Federal works and kept up till night fall. Altogether, one building in the Navy Yard was set on fire; only minor damage was done the forts; while there were no casualties at all—indeed, no results except a waste of ammunition.

On May 9, 1862, Pensacola was burned and evacuated and subsequently became headquarters for the West Gulf Squadron.

The data found in the Official Records of the Union and Confederate Armies are very incomplete, the Confederate reports being wholly missing.

COMMENTS

The number of hits made was very small for the number of rounds fired.

An example of an intended capture of a work by a force landing and making a night attack, but successfully beaten off by troops camped outside the work.

AUTHORITIES

Official Records of the Union and Confederate Armies,
  Series I, Vol. 1, pp. 333-342, 349, 421-455.
  Series I, Vol. 6, pp. 495, 496.
  Plate 5, Atlas.
Battles and Leaders of the Civil War, Vol. I, pp. 26-32.

MEDICAL SERVICE IN THE FIELD

A lecture delivered before the student officers in the Department of Artillery and Land Defense of the Coast Artillery School.

By Major FREDERICK P. REYNOLDS, Medical Corps

The evolution of the medical department of an army in the field has gone hand in hand with that of the combatant units, conforming to the changing conditions of modern warfare. Until recently, however, the medical department has not been looked upon as a military necessity or as useful in a tactical sense, its humanitarian function having been regarded as its only one. This has of late assumed a secondary importance, for other functions of a technical nature, made possible by the advancement of knowledge, have placed the sanitary service on a footing with other special troops and made it, like them, necessary for military success. Now it finds its sphere of greatest usefulness in maintaining a maximum physical efficiency, thereby contributing directly to the fighting effectiveness. Its second important function, likewise essentially military in character, is to relieve the field forces of their incumbrance of sick and wounded. The professional care of the latter also devolves upon the sanitary service, as does the provision and replenishment of all medical supplies.

The arrangements for collecting and evacuating the sick and wounded is the feature we are about to discuss, and I have thought it might be convenient to consider it under the heads of: (1) the work to be done; (2) the organization which has been provided; and (3) the duties of the units of the organization in camp, on the march, and in action.

The medical department of the army has under its care in time of peace, that is, at present, between three and four per cent of the commissioned and enlisted personnel. In time of war it must be prepared to care for more than twice this number, providing every item for the well-being of the men, their medical and surgical treatment, their feeding, clothing, transportation, and accounts, from the time the individuals fall out of ranks until they are returned thereto or leave the service by death, discharge, or otherwise. Beginning at the front, first aid is to be provided, for which experienced and trained personnel is required. Then transportation to the field hospitals by litter and ambulance by way of the aid stations, at each of which important work is to be performed; and lastly, evacuation to the rear along the lines of communication by ambulances, wagons, hospital trains, and hospital ships to the base and general hospitals and convalescent camps, where provision is found for final treatment and disposition. Part of the equipment needed is furnished by the medical department, and all of it and the units of which it is a part, are manned, administered, and controlled by the sanitary service.

The personnel is composed of medical officers, enlisted men of the Hospital Corps, and civilians in considerable numbers, such as nurses, cooks, clerks, scavengers, carpenters, plumbers, laborers, etc. It is contemplated that organized volunteer aid, such as furnished by the Red Cross, shall largely be used in the work in rear of the fighting troops. The Red Cross will supply, for example, most of the personnel of general hospitals, and will be prepared to furnish trained personnel for the taking over of special branches of hospital and transport work, besides the collecting, forwarding, and distributing of Red Cross supplies of all kinds.

An estimate of the personnel needed at once *at the front* upon mobilization is, of medical officers, about 8 per 1000 of combatant troops, and of Hospital Corps men, six per cent of the combatant troops. These figures are based upon the requirements of Field Service Regulations. Experience has shown that in future wars we shall probably need nearly 1% of medical ofcers and 9% of Hospital Corps men to perform all the work of the front and rear. A medical personnel of 10 % is not, therefore, to be considered as excessive from the standpoint of probable needs, or indeed, of the provision made in other armies.

The units of the medical field organization are of three classes: those of the front, those on the lines, and those at the base, which operate in three zones usually designated as the collecting, evacuating, and distributing zones. These are linked, and it is essential that the links be not broken, and that the personnel of the front be not sent further back. The movement of the sick and wounded must be continuous and uninterrupted, if the service is to be successful.

Independent medical units operating with troops at the front are ambulance companies and field hospitals, which are divisional units. The functions of the former are to render first aid to the wounded and to collect and transport them, usually to field hospitals, which latter receive them and provide them shelter and treatment until they can be turned over to the service of the rear. For each regiment there is provided an independent medical personnel and equipment, the latter constituting a regimental infirmary, to be expanded into a regimental hospital, if the regiment be detached for independent service. Regulations also provide a personnel and an equipment for the smaller independent units, such as engineer battalions, Signal Corps companies, etc.

The characteristic feature of the service of the lines is the evacuation hospital (of 324 beds), which receives the sick and wounded of the troops at the front. These are mobile, being held at rail or water heads, to be pushed to the front with the advance depots. Their equipment enables them to expand considerably in emergencies. Transportation units on the lines consist of transport columns (similar in organization and equipment to ambulance companies), hospital trains and hospital ships, frequently supplemented by emergency transportation in the form of automobiles and other wheeled vehicles of the country, native bearers, steam and electric rail transportation, and boats of various kinds, which may be turned over to the medical department for temporary use. The usual estimate for sick transport on the lines is 3%, that is, the daily losses from all causes in a field force usually approximate this number. At the base and at home are located base and general hospitals, convalescent camps, supply depots and rendezvous for recruitment, schools for medical officers, and companies of instruction for enlisted men.

Upon mobilization, the ordinary provision of hospital accommodation is for 10% of the troops, of which about 4% of beds is in general hospitals in home territory and 6% along the lines and at the base in base and evacuation hospitals, one of the former and two of the latter being provided for each division at the front. Beds in field hospitals are not included in this estimate. Factors influencing the estimate of the sick and wounded that are to be expected, are the nature of the campaign and the character of the country in which it is to take place, the season, the climate, the experience and training of the troops forming the expeditionary force, their familiarity with the country, and the provisions for removal home.

Besides the usual sanitary and strictly professional duties with troops in the field, the duties of the medical department of a mobilization camp include physical examinations of officers and men, and the enlistment, organization, equipment, and instruction of the personnel of the sanitary field units. There are administrative medical officers and sanitary inspectors, a depot or a general hospital, a medical supply depot with quartermaster's and ordnance stores, one or more Hospital Corps companies of instruction, and a school for medical officers.

The sanitary personnel for duty with a regiment consists of 4 medical officers, the senior of whom acts as regimental surgeon, 4 non-commissioned officers, and 20 privates first class and privates. The equipment constitutes the regimental infirmary, which cares for minor cases only, the seriously ill being promptly transferred to the field hospital. Its transportation consists of a field wagon and a pack mule. By additions to its equipment the infirmary becomes a regimental hospital, if the regiment is so isolated that patients cannot readily be transferred. It is then prepared to care for 18 bed patients, being in reality a section of a field hospital.

A field hospital has a personnel of 5 medical officers, 58 non-commissioned officers and men, with tentage for 108 patients. Its transportation consists of 8 field wagons, 2 of which carry baggage, rations, and forage, and 6 the tentage and hospital equipment. The greater part of the latter is packed in chests and similar small containers of uniform size, which, when a hospital is pitched, can readily be distributed to the departments to which they pertain and as readily be packed and assembled. Reserve supplies are carried so that a 20% casulaty may be cared for. A field hospital may be unpacked, pitched, and made ready for its quota of patients in less than an hour.

Both the field hospital and the ambulance company are essentially mobile units marching and halting with the command to which they are attached. In camp the field hospital cares for the sick transferred to it by the regimental infirmary, sending to the rear cases whose treatment will be prolonged or whose stay at the front would be a menace to the health of the troops.

As previously stated, the functions of an ambulance company are to render first aid and to collect and transport the sick and wounded. In camp its work is that of transportation only. Its personnel consists of 5 medical officers and 78 non-commissioned officers and men, with the camp equipage of a company of infantry. Its transportation includes 12 ambulances, 3 field wagons, one carrying the equipment of a dressing station, and 4 pack mules. A section of the company personnel constitutes a bearer detachment, the members of which in action work with litters between the regimental aid stations at the front and the dressing station.

The sanitary troops of a complete division consist of a chief surgeon with two assistants, a sanitary inspector, 4 ambulance companies, and 4 field hospitals, with the regimental detachments and smaller detachments for the divisional troops, engineers, Signal Corps, etc. There are also two medical officers, who are known as directors of ambulance companies and of field hospitals, assisting the chief surgeon in his administration of these organizations.

It can readily be understood that time is required to instruct the personnel in many duties besides the care of the sick, and that discipline and training are essential for good service amid the confusion and, at times, the demoralization in the rear of troops in action. It will be observed that our field medical organization, with the exception of 4 ambulance companies and 4 field hospitals, has no existence in time of peace. It is unfortunate that the duties of the medical department in peace give very little training for its function in war.

The medical service on the march is described in detail in par. 738, of Field Service Regulations. The senior medical officer of the regiment is with the regimental staff. The battalion being a tactical unit, regulations provide in advance for its sanitary needs when operating independently. One ambulance detached from the ambulance company marches in the rear of each regiment. A regiment operating alone is accompanied by 3 ambulances. Field hospitals and ambulance companies march in the rear of the division field train, unless an engagement is imminent, when they precede the train; and the personnel of the ambulance companies, with pack mules carrying the dressing station equipment, follow the combatant organizations. An advance guard is provided for by a section of an ambulance company; or, in the case of the advance guard of a division, a complete ambulance company might be assigned march in its immediate rear, preceding the main body.

A brief statement of the needs of the wounded might perhaps properly precede a description of the working of the sanitary service during an engagement.

In the order of their frequency, the causes of death from gunshot wounds are infection, shock, destruction of a vital organ, and hemorrhage. To prevent death and disability from these causes and to relieve the attendant suffering should, therefore, be the chief end of first aid. Of the causes of death I have mentioned, infection is in all ways the most important for us to consider, for it is not only the most frequent, but it is also the one we can most influence by relief measures. For in the great majority of gunshot wounds in war, recovery may confidently be expected if infection is prevented, unless a vital organ has been seriously damaged. The proper application of the first aid packet is, then, of the greatest importance. It has been said that the fate of the wounded is in the hands of the man who applies the first aid dressing.

Besides a protective dressing, the wounded man may need immediate treatment for hemorrhage, support for a fracture, or relief for severe pain. A large proportion of the wounded require transportation and some are so severely wounded that they should not be moved, but must be cared for where they fall. All should have shelter and, with the exception of the desperately wounded, all will need nourishment.

The conditions of modern battlefields are all unfavorable for the work of caring for the wounded. Limited transportation reduces the equipment which can be brought forward to bare necessities. The soldier's physical condition and the dirt on his skin and his clothing are not favorable for clean surgical work. The clothing and hands of the medical officers and of the Hospital Corps men are likewise soiled, and there are usually no facilities for cleansing. Because of the severity of rifle fire, it is often impossible to reach the wounded man for hours after he receives his injury. Also, the large number of casualties which occur within a short time overwhelms the sanitary service. It therefore happens that ordinarily but a small proportion of wounded can be reached as they fall, and that the majority must depend upon themselves or a comrade for their first dressing. The unfavorable conditions are, therefore, a lack of any but the simplest supplies and of all facilities for cleansing wounds, an inability of trained attendants to render early aid, to remove the wounded, or to provide them with shelter until late in the engagement or until after it is over.

A casualty of 10% in a division of full strength means that over 1800 are either killed or wounded. Accepting the statistics of recent wars, it may be assumed that of the total casualty:

20%, or 360, will be dead upon the field;
8%, or 144, will be so severely wounded that it will be inadvisable to move them;
40%, or 720, can walk; about half, or 360, walking to the station for slightly wounded at the rear, and the remainder walking to the dressing station;
32%, or 576, will require transportation.

These percentages are used in estimating the amount of transportation required and in calculating the time necessary for clearing a field of dead and wounded. It will be noticed that of a given casualty about 40% will be able to walk and the same number will be so seriously wounded as to require transportation; 8% of these latter, however, because of the nature of their wounds, should not be moved from the immediate vicinity in which they fall. In recent wars the mortality among those of the wounded that have been collected and transported to the rear, has been but 3% to 6%. Two-thirds of the wounded need not be sent further to the rear than the base, as this proportion will probably be fit for duty within a reasonable time. In the Manchurian campaign one-third of the Japanese wounded returned to the ranks within a month.

Preliminary to an action, the field hospitals are cleared of their sick; evacuation hospitals and transport columns are advanced as far as possible toward the front; base hospitals are prepared; and such additional transportation along the lines as may be indicated, is assigned.

The aid stations established by the sanitary troops during an action are four in number and are from front to rear: regimental first aid stations, dressing stations, field hospitals, and stations for the slightly wounded.

Par. 4 of division field orders will usually designate the place of establishment of the latter station, in order that all the troops may be informed; and it will designate the location of dressing stations and of field hospitals, whenever it is possible to fix them in advance. Par. 4 will indicate also the assignment of additional transportation in the shape of empty wagons.

The slightly wounded station is intended for wounded who are able to walk some distance and who do not require hospital care and treatment, relieving the dressing station and field hospitals of a troublesome class of cases, which otherwise might overtax them. The station is usually located two or three miles from the front. It should be easily approachable from all parts of the line, and some distance from the field hospitals and dressing stations, not directly on the main route of approach from the rear. In an assumed casualty of 10%, we may expect to have 300 to 500 slightly wounded to be cared for in the division.

It might be stated that wounded are found distributed in what are called "zones of losses." The usual proportion in each zone is about as follows: From the early casualties up to 1,000 yards, 20%; 1,000 to 400 yards, 60%; in the final rush, 10%; and in the pursuit, 10%. It is, however, only after fighting has ceased that it is possible to get definite knowledge of the distribution of the wounded on the field.

The field hospitals are at the beginning of an action assigned tentative locations by the chief surgeon, with authority of the division commander, but are not pitched until the tactical situation develops and the point where the main attack will be made becomes known. They are then pitched, as needed, in locations most convenient to the zone of greatest losses. The chief considerations in the selection of a site are that it be beyond the range of rifle fire; that it be accessible to the front by road and on a line of evacuation to the rear; that it be off the route of marching troops and away from strategic points; that it be supplied with wood and water; and that buildings be at hand to receive an overflow. The shelter and other resources of a town are of much advantage. Field hospitals are often set up at dressing stations, taking over the wounded there collected.

The camp of the ambulance company is near the field hospital. From this point the company goes forward, usually with ambulances, and as soon as the advance ceases, establishes the dressing station, which is the next station as we go toward the front. The equipment of the dressing station is carried by a wagon or by pack mules, and consists of food and surgical supplies in considerable quantities and a simple mess outfit. The work of the station comprises the speedy dressing of the wounded, caring for the mortally wounded, giving food and stimulants to those needing them, returning trifling cases to the front, making records, and classifying and forwarding those who are to be sent to the rear. From the dressing station go forward the bearer parties, of which there are usually three, who find the regimental aid stations and assist in the work there, carrying back to the dressing station the wounded who cannot walk.

For obvious reasons the dressing station should be located as near the front as safety permits. Protection from fire is the primary consideration. Cover is therefore to be sought, with accessibility to the zone of losses, and with roads to the rear for ambulances. Wood, water, and shelter are desired. A farm house often combines these advantages and is selected.

The regimental first aid station is established by the senior surgeon, under authority of the regimental commander. The equipment is carried on a pack mule. Its function is to collect and give first aid to the wounded of the regiment and to prepare them for transportation to the rear. The chief concern of the regimental surgeon is to maintain constant touch with the firing line. Therefore, he does not locate the station until the advance has ceased and the type of engagement is determined. To be out of range of overshots is the first consideration, the limit of the zone of which is estimated at 3000 yards from the firing point. Cover may, of course, often be found within this zone and buildings may offer the necessary protection. Accessibility from the rear by ambulance is highly desirable.

To recapitulate,—

The stations established by sanitary troops at the front for the collection and care of the wounded during and after an engagement, are (from the rear forward):

1. The station for slightly wounded.
2. The field hospital.
3. The dressing station.
4. The regimental first aid station.

Stations for slightly wounded, usually one to a division, are established by small detachments of medical officers and Hospital Corps men detailed from divisional troops, such as engineers, with equipment from the reserve supply.

Field hospitals are located by the division commander or, with his authority, by the chief surgeon.

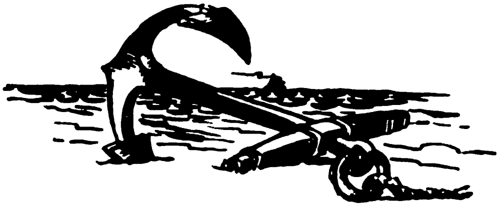
Dressing stations are established and manned by the ambulance company personnel, and regimental first aid stations by the regimental detachments.

Wounded collected at the first aid stations are taken in charge by bearers of the dressing station parties and carried by litter or conducted to dressing stations. Here the wounded are examined and classified, dressings are inspected or re-applied, urgent operations performed, food and stimulants given, records made, tags applied, and wounded forwarded by ambulance to the field hospitals.

An estimate of a sanitary situation is arrived at in much the same manner as is an estimate of a military situation, and is indeed a part of the latter. An understanding of the general military situation is necessary for an intelligent comprehension of the sanitary situation; and, moreover, certain features of the general military situation bear especially upon the sanitary aspects of a problem, such as the nature of the undertaking; that is, the mission of the commander of the troops, information regarding the enemy, and other conditions as regards our own troops which might influence medical arrangements—discipline, training, and physical condition, for instance. We next determine the sanitary formations to be used and those to be held in reserve, their location, utility and sufficiency; then the available transportation, including railways, trolleys, requisitioned vehicles and empty wagons; and lastly, the location of the wounded and the influence of the terrain and weather upon the work of collection.

The time required for the policing of a battlefield depends upon certain factors most important of which are the number of casualties, the character of the wounds as affecting transportation, the distribution of the wounded on the field, the available transportation, the distance the wounded are to be transported, the terrain, soil, vegetation, weather, and season.

In clearing the field, the labor of digging the graves is an important feature of the problem. Dead are usually buried in trenches. Under ordinary conditions 500 men (say one battalion) can dig trenches for 140 bodies in about an hour.



MANUAL FOR POST AND DISTRICT ORDNANCE OFFICERS

By Captain MARK L. IRELAND, Coast Artillery Corps

Previous contributions on this subject by the author have appeared in the Journal for May-June, 1911, page 270, and for May-June, 1912, page 378.

The matter following is that part devoted to a chronological memorandum, or "Tickler," for the paper and office work of ordnance officers. The dividing lines are intended to indicate the matter which, with the headings repeated, would appear on the separate date cards of a card "Tickler." This scheme will be recognized as an adaptation of the idea of Capt. James A. Moss, 24th U. S. Infantry, to the work of post and district ordnance officers. The part applying to the post ordnance officer covers the work of ordnance officers of the mobile army.

This contribution will be followed later by a similar memorandum list covering the out-of-door and non-paper work, the division in presentation coinciding with the usual division of work between ordnance sergeants and the other personnel of the ordnance department of a post or district.

This paper is offered to the service subject to criticism and suggestion, as was the chapter on Armament Caretakers published in the May-June, 1912, number of the Journal.

All changes in the quoted authorities made up to September 25, 1912, have been incorporated. The abbreviations used, are, with a few exceptions, those given on pages 245 and 246 of "A Guide for the Use of Officers of the Inspector General's Department," revised to include December 26, 1911. O. P. R. indicates "Ordnance Property Regulations, 1909;" and C. A. D. R., "Coast Artillery Drill Regulations, 1909." When no authority is given, the entry is a suggestion on the author's own responsibility. When the department which issues the form is not given, the Ordnance Department form of that number is meant.

PAPERS ORIGINATING IN, OR PASSING THROUGH, THE ARTILLERY DISTRICT ORDNANCE OFFICE

ALSO ACTION BY THE DISTRICT ORDNANCE OFFICER ENJOINED BY ARMY REGULATIONS, ORDERS, AND CUSTOM.

(*Study carefully all the notes on every form.*)

EVERY MONTH

Date	Subject or Occasion	Form	Authority	Remarks
1st	Time report for each machinist and helper, showing work performed in detail.	1219	Par. 24, Sec. IV, G.O. 62, '08.	To District Armament Officer. First report for each enlisted helper must be accompanied by copy of order placing him on extra duty as helper.
			D.J.A.G.: Pay and allowances, IC 6b. A.R. 169.	No extra duty pay allowed for helpers employed for periods of less than 10 days (80 hours).
	Time card for 24th to last of preceding month for each civilian employee of the Ordnance Department.	2586	Par. III, G.O. 102, '09.	To District Armament Officer.
2nd	Usual limit for rendition of time cards of civilian employees at other posts in the district.	2586	Par. III, G.O. 102, '09.	To District Armament Officer.
9th	Time card for 1st to 8th of this month for each civilian employee of the Ord. Dept.	2586	Par. III, G.O. 102, '09.	To District Armament Officer.
10th	Same as for the second of the month.			
16th	Time card for 9th to 15th of this month for each civilian employee of the Ord. Dept.	2586	Par. III, G.O. 102, '09.	To District Armament Officer.

EVERY MONTH (continued)

Date	Subject or Occasion	Form	Authority	Remarks
16th	Memorandum of all incomplete property transactions of longer standing than fifteen days.			Placed on Ordnance Officer's desk.
17th	Same as for the second of the month.			
24th	Time card for 16th to 23rd of this month for each civilian employee of the Ord. Dept.	2586	Par. III, G.O. 102, '09.	To District Armament Officer.
25th	Same as for the Second of the month.			
Last Day	Progress report on work in artillery district.	See sample, form page 350.	Letter from Dist. Armament Officer, April 15, '11.	To District Armament Officer.

JANUARY

2nd	Certificates of inventory of artillery ammunition by all responsible officers due this date.	See sample, page 349.	O.P.R. 209.	Forwarded with semi-annual return on 20th.
	Statement of ammunition, fire control instruments, etc. One statement for each post and sub-post in district.	70	O. P. R. 225 as amended by A. G. O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance, through the District Armament Officer.
	Quarterly report of fuel and power consumed in district repair shop.	Letter. See sample, page 350.	A. R. 682. Cir. 78, '09. Letter from Arm. Officer, June 30, '10.	To District Armament Officer, giving names of issuing quartermasters, quantities, and contract price per 100 lbs., per gal., or per KW-hour.

JANUARY (continued)

Date	Subject or Occasion	Form	Authority	Remarks
2nd	Quarterly requisition for blank books and forms, giving number and name.	Letter. Form 388 may be used.	O. P. R. 91. A. R. 1573 and 1593.	Directly to Chief of Ordnance by officer using forms. In Philippines, to Chief Ordnance Officer.
3rd	Usual limit for rendition of statement of ammunition, fire control instruments, etc., by post ordnance officers.	70	O. P. R. 225 as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance, through the District Armament Officer.
10th	Requisitions for annual and semi-annual allowances of ordnance stores. (Good administration requires that all necessities be covered by annual and semi-annual requisitions. April and October requisitions should be rare and limited to contingencies which could not be forseen.)	388	O. P. R. 72*. O. P. R. 73*. O. P. R. 74*. *As amended by G. O. 8, '11.	In duplicate, to the Chief Ordnance Officer of the Division, through the Artillery District Commander. In duplicate, to the District Armament Officer, through the Artillery District Commander. See notes on preparation of.
20th	Semi-annual property return and list of pyramidal targets and component parts destroyed in practice with submarine mine equipment.	15, 16, 19, 20, 23, 25.	O. P. R. 190, 200, and 207. A.R. 1571. Cir. 27, '10.	One copy, with one copy of all vouchers and inventories of ammunition, directly to Chief of Ordnance. In Philippines, through Chief Ordnance Officer.
	Ordnance Officer's individual return for horse equipments.	18-A	A.R. 1512.	One copy, with one copy of all vouchers, directly to the Chief of Ordnance. In Philippines, through Chief Ordnance Officer.
21st	Check list of copies of all confidential records emanating from District Ordnance Office.		Par. X, G.O. 3, '12.	

JANUARY—Continued.

Date	Subject of Operation	Form	Authority	Remarks
[illegible]	Check the condition of emplacement books		C.A.M. 7. '10.	Initial all entries made under your supervision.

FEBRUARY

Date	Subject of Operation	Form	Authority	Remarks
1st	Requisitions for explosives and ammunition. (They will anticipate the need sufficiently to allow the most economical means of transportation.)	388	O.P.R. 72*, 73*, and 92. *As amended by G.O. 8, '11.	In duplicate, to the Chief Ordnance Officer of the Division, through the Artillery District Commander. Annual ammunition allowance order is published in time to reach post about Feb. 1st.

MARCH

Date	Subject of Operation	Form	Authority	Remarks
[illegible]	[illegible]	[illegible]		To all parties (except post ordnance officers) who hold district ordnance property on memorandum receipt.

APRIL (continued)

Date	Subject or Occasion	Form	Authority	Remarks
1st	Quarterly report of fuel and power consumed in district repair shop.	Letter. See sample, page 350.	A.R. 682. Cir. 78, '09. Letter from Arm. Officer, June 30, '10.	To District Armament Officer, giving names of issuing quartermaster, quantities, and contract price per 100 lbs., per gal., or per KW-hour.
	Quarterly requisition for blank books and forms, giving number and name.	Letter. Form 388 may be used.	O.P.R. 91. A.R. 1573 and 1593.	Directly to Chief of Ordnance by officer using forms. In Philippines, to Chief Ordnance officer.
2nd	Usual limit for rendition of statement of ammunition, fire control instruments, etc., by post ordnance officers.	70	O.P.R. 225, as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance, through the District Armament Officer.
10th	Requisitions for property. (Good administration requires that all necessities be covered by annual and semi-annual requisitions. April and October requisitions should be rare and limited to contingencies which could not be foreseen.)	388	O.P.R. 72*. O.P.R. 73*.	In duplicate, to the Chief Ordnance Officer of the Division, through the Artillery District Commander.
			O.P.R. 74*. *As amended by G.O. 8, '11.	In duplicate, to the District Armament Officer, through the Artillery District Commander. See notes on preparation of.

MAY

Date	Subject or Occasion	Form	Authority	Remarks
1st	Check the condition of emplacement books.		C.A.M.7, '10.	Initial all entries made under your supervision.

JANUARY (continued)

Date	Subject or Occasion	Form	Authority	Remarks
22nd	Check the condition of emplacement books.		C.A.M. 7, '10.	Initial all entries made under your supervis-sion.

FEBRUARY

Date	Subject or Occasion	Form	Authority	Remarks
1st	Requisitions for explosives and ammunition. (They will anticipate the need sufficiently to allow the most economical means of transportation.)	388	O.P.R. 72*, 73*, and 92. *As amended by G.O. 8, '11.	In duplicate, to the Chief Ordnance Officer of the Division, through the Artillery District Commander. Annual ammunition allowance order is published in time to reach post about Feb. 1st.

MARCH

Date	Subject or Occasion	Form	Authority	Remarks
10th	Request for memorandum of all repairs, spare parts, etc., needed for maintenance during next quarter.	Mimeographed letter. See sample, page 349.		To all parties (except post ordnance officers) who hold district ordnance property on memorandum receipt.
20th	Settlement of *all* memorandum receipts.			

APRIL

Date	Subject or Occasion	Form	Authority	Remarks
1st	Statement of ammunition, fire control instruments, etc. One statement for each post and sub-post in district.	70	O.P.R. 225, as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance, through the District Armament Officer.

APRIL (continued)

Date	Subject or Occasion	Form	Authority	Remarks
1st	Quarterly report of fuel and power consumed in district repair shop.	Letter. See sample, page 350.	A.R. 682. Cir. 78, '09. Letter from Arm. Officer, June 30, '10.	To District Armament Officer, giving names of issuing quartermaster, quantities, and contract price per 100 lbs., per gal., or per KW-hour.
	Quarterly requisition for blank books and forms, giving number and name.	Letter. Form 388 may be used.	O.P.R. 91. A.R. 1573 and 1593.	Directly to Chief of Ordnance by officer using forms. In Philippines, to Chief Ordnance officer.
2nd	Usual limit for rendition of statement of ammunition, fire control instruments, etc., by post ordnance officers.	70	O.P.R. 225, as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance, through the District Armament Officer.
10th	Requisitions for property. (Good administration requires that all necessities be covered by annual and semi-annual requisitions. April and October requisitions should be rare and limited to contingencies which could not be foreseen.)	388	O.P.R. 72*. O.P.R. 73*. O.P.R. 74*. *As amended by G.O. 8, '11.	In duplicate, to the Chief Ordnance Officer of the Division, through the Artillery District Commander. In duplicate, to the District Armament Officer, through the Artillery District Commander. See notes on preparation of.

MAY

Date	Subject or Occasion	Form	Authority	Remarks
1st	Check the condition of emplacement books.		C.A.M.7, '10.	Initial all entries made under your supervision.

JUNE

Date	Subject or Occasion	Form	Authority	Remarks
10th	Request for memorandum of all repairs, spare parts, etc., needed for maintenance during next quarter.	Mimeographed letter. See sample, page 349.		To all parties (except post ordnance officers) who hold district ordnance property on memorandum receipt.
15th	Blank certificates of inventory of artillery ammunition for end of accounting period for each responsible officer.	See sample, page 349.	O.P.R. 209.	Sufficient copies to each post ordnance officer (including headquarters post) for himself and each battery commander at his post. Certificate for accountable officer is on inside of back cover of return.
20th	Settlement of *all* memorandum receipts.			

JULY

Date	Subject or Occasion	Form	Authority	Remarks
1st	Certificates of inventory of artillery ammunition by all responsible officers due this date.	See sample, page 349.	O.P.R. 209.	Forward with semi-annual return on 20th.
	Statement of ammunition, fire control instruments, etc. One statement for each post and sub-post in district.	70	O.P.R. 225, as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance, through the District Armament Officer.
	Quarterly report of fuel and power consumed in district repair shop.	Letter, See sample, page 350.	A.R. 682. Cir. 78, '09. Letter from Arm. Officer, June 30, '10.	To District Armament Officer, giving names of issuing quartermasters, quantities and contract price per 100 lbs., per gal., or per KW-hour.

JULY (continued)

Date	Subject or Occasion	Form	Authority	Remarks
1st	Quarterly requisition for blank books and forms, giving number and name.	Letter. Form 388 may be used.	O.P.R. 91. A.R. 1573 and 1593.	Directly to the Chief of Ordnance by officer using forms. In Philippines, to Chief Ordnance Officer.
2nd	Usual limit for rendition of statement of ammunition, fire control instruments, etc., by post ordnance officers.	70	O.P.R. 225 as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance, through the District Armament Officer.
10th	Requisitions for annual and semi-annual allowances of ordnance stores. (Good administration requires that all necessities be covered by annual and semi-annual requisitions. April and October requisitions should be rare and limited to contingencies which could not be forseen.	188	O.P.R. 72*. O.P.R. 73*.	In duplicate, to the Chief Ordnance Officer of the Division, through the Artillery District Commander.
			O.P.R. 74*. *As amended by G.O. 8, '11.	In duplicate, to the District Armament Officer, through the Artillery District Commander. See notes on preparation of.
20th	Semi-annual property return and list of pyramidal targets and component parts destroyed in practice with submarine mine equipment.	15, 16, 19, 20, 23, 25.	O.P.R. 190, 200, and 207. A.R. 1571. Cir. 27, '10.	One copy, with one copy of all vouchers and inventories of ammunition, directly to Chief of Ordnance. In Philippines, through Chief Ordnance Officer.
	Ordnance officer's invidual return for horse equipments.	18-A	A.R. 1542.	One copy, with one copy of all vouchers, directly to the Chief of Ordnance. In Philippines, through Chief Ordnance Officer.

SEPTEMBER

Date	Subject or Occasion	Form	Authority	Remarks
10th	Request for memorandum of all repairs, spare parts, etc., needed for maintenance during next quarter.	Mimeographed letter. See sample, page 349.		To all parties (except post ordnance officers) who hold district ordnance property on memorandum receipt.
20th	Settlement of *all* memorandum receipts.			
		OCTOBER		
1st	Statement of ammunition, fire control instruments, etc. One statement for each post and sub-post in district.	70	O.P.R. 225 as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance, through the District Armament Officer.
	Quarterly report of fuel and power consumed in district repair shop.	Letter. See sample, page 350.	A.R. 682. Cir. 78, '09. Letter from Arm. Officer June 30, '10.	To District Armament Officer, giving names of issuing quartermaster, quantities, and contract price per 100 lbs., per gal., or per KW-hour.
	Quarterly requisition for blank books and forms, giving number and name.	Letter. Form 388 may be used.	O.P.R. 91. A.R. 1573 and 1593.	Directly to Chief of Ordnance by officer using forms. In Philippines, to Chief Ordnance Officer.
2nd	Usual limit for rendition of statement of ammunition fire control instruments, etc., by post ordnance officers.	70	O.P.R. 225 as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance, through the District Armament Officer.

OCTOBER (continued)

Date	Subject or Occasion	Form	Authority	Remarks
10th	Requisitions for property. (Good administration requires that all necessities be covered by annual and semi-requisitions. April and October requisitions should be rare and limited to contingencies which could not be foreseen.)	388	O.P.R. 72*. O.P.R. 73*. O.P.R. 74*. *As amended by G.O. 8, '11.	In duplicate, to Chief Ordnance Officer of the Division, through the Artillery District Commander. In duplicate, to the District Armament Officer, through the Artillery District Commander. See notes on the preparation of.
11th	Check the condition of emplacement books.		C.A.M. 7, '10.	Initial all entries made under your supervision.

DECEMBER

Date	Subject or Occasion	Form	Authority	Remarks
10th	Request for memorandum of all repairs, spare parts, etc., needed for maintenance during next quarter.	Mimeographed letter. See sample, page 349.		To all parties (except post ordnance officers) who hold district ordnance property on memorandum receipt.
15th	Blank certificates of inventory of artillery ammunition for end of accounting period for each responsible officer.	See sample. page 349.	O.P.R. 209.	Sufficient copies to each post ordnance officer (including headquarters post) for himself and each battery commander at his post. Certificate for accountable officer is on inside of back cover of return.
20th	Settlement of *all* memorandum receipts.			
31st	Personal report rendered by each ordnance sergeant.	1519 A.G.O.	A.R. 100.	Ordnance officer indorses his opinion of the manner in which the ordnance sergeant has performed his duty and forwards each report through the commanding officer directly to The Adjutant General of the Army.

WHEN THE OCCASION ARISES

Subject or Occasion	Form	Authority	Remarks
Cartridge storage case leaking or with broken seal.	Letter.	C.A.D.R. 972.	To The Adjutant General of the Army.
Cartridge storage cases sealed with paraffin, if contained charges are not to be used within six months from date of opening.	Letter.	C.A.D.R. 883.	To the District Armament Officer, who will cause cases to be resoldered.
Clerk, detail of non-commissioned officer as.	Letter.	A.R. 170.	To Department Commander, for authority. Authority, when granted, covers the position, not the individual detailed.
Employee, civilian, of ordnance department, completes work, at or leaves post, post ordnance officer renders time card.	2586	Par. III, G.O. 102, '09.	To District Armament Officer, through Artillery District Ordnance Officer.
When employee is transferred out of district, district ordnance officer renders time card.			To District Armament Officer, if quarter month pay period is complete. If not, to officer under whom pay period will be completed.
When employee completes work or leaves station of mobile battery, officer accountable for property on which work is performed renders time card covering date and hour of arrival and manner in which employee conducted himself. Regiment and battalion adjutants are accountable for property issued to their headquarters.	2586 or Letter.	G. O. 9, '11. G.O. 6, 1912 Par. VI, G.O. 3, '12.	To officer of the Ordnance Department charged with repair and alteration of materiel of battery. If work falls in more than one of quarter month pay periods, separate reports for each period should be made.

WHEN THE OCCASION ARISES (continued)

Subject or Occasion	Form	Authority	Remarks
Exercises, Joint Army and Mlilita Coast Defense. See Militia.			
Explosive D, when interior of barrel is found wet.	Letter.	C.A.D.R. 941.	To The Adjutant General of the Army.
Fire control, distribution of instruments. See *instruments in fire control system.*			
Firing, proof, of cannon and carriage, notification that same has been completed and that cannon and carriage are ready for use.	Letter.	G.O. 220, '10.	From District Armament Officer. File in emplacement book. Firing by artillery is prohibited until this is received.
Firing, records of artillery. (Records for batteries in commission are forwarded by battery commander.)	935 or 819A 819B	A.R. 1572.	One copy of, directly to the Chief of Ordnance. Other copies as prescribed on form.
Instruments in fire control system, distribution of, whenever a change occurs in, district ordnance officer revises tabular statement and forwards prints. This is strictly a confidential record falling in class (d).	Tracing.	Letter, O.C.C.A., Sept. 16, '09 (1st Ind., A.G.O., Sept. 23, '09). Par. X, G.O. 3, '12.	Six prints to Adjutant General of Division, for Coast Defense Officer, and for War Department. Letter of transmittal will be unnecessary if tracing quotes authority. Prints must be serially numbered and recorded.
Instruments and telescopes, when repairs are needed which cannot be made at the post. (This means within the artillery district.)	Letter.	C.A.D.R. 887.	To District Armament Officer.

WHEN THE OCCASION ARISES (continued)

Subject or Occasion	Form	Authority	Remarks
Inventory and inspection reports, signed by responsible officer. (For detailed information as to classes of property which may be surveyed and methods to be followed, see Guide for I.G.D. 243 to 290 inclusive.)	1 I.G.D.	A.R. 916, 921. Guide for I.G.D. 261, 1498.	In duplicate, to inspector, who returns them to accountable officer, except in cases requiring approval of higher authority.
Mechanic completes work at or leaves post, post ordnance officer renders time report.	1219	Sec. 24, Par. IV, G.O. 62, '08.	To District Armament Officer, through Artillery District Ordnance Officer.
When mechanic is transferred out of district, district ordnance officer renders time report.			To District Armament Officer, if month is complete. If not, to officer under whom month will be completed.
Militia: Expenditures of artillery ammunition, separate certificate of, by post ordnance officer responsible, approved by district commander.	19	G.O. 9, '12.	One copy directly to Chief of Ordnance. Two copies retained with current property return.
Expenditures of artillery ammunition, invoices and receipts for, prepared by district ordnance officer.	146	G.O. 9, '12.	In triplicate, to Governor of State concerned. Upon return of receipts, one copy sent directly to Chief of Ordnance, two copies filed with current return.
Ordnance sergeant reports date of leaving former station and date of arrival at new station. Makes similar report upon return from any detached duty, furlough, or other absence.	Letter.	A.R. 100.	To Chief of Ordnance, through commanding officer.

WHEN THE OCCASION ARISES (continued)

Subject or Occasion	Form	Authority	Remarks
Powder, smokeless, when tenth-normal methyl violet paper whitens in less than one month.	2599	C.A.D.R. 976.	To The Adjutant General of the Army.
Purchases by district or post ordnance officer; purchasing officer forwards abstract of purchases and takes up property on his return.	219, 220.	O.P.R. 128.	To Chief of Ordnance, through designated disbursing officer. Abstract of purchases is voucher to return of accountable officer but is not required to accompany it.
Purchases by oral agreement. Limit for emergency purchases for repairs to armament and its appurtenances on the authority of the artillery district ordnance officer, $50.00.	Letter	A.R. 558, 559, 560. O.P.R. 128. O.O. 34348. A-238, Oct. 19, '04.	To District Armament Officer, inclosing bills in duplicate, with brief explanation of circumstances.
Repairs. See *work.*			
Repairs to Seacoast Armament and its Appurtenances, when it is necessary to incur small expenses for material or labor for, when local market conditions make it economical and advantageous, Artillery District Commander requests authority.	Letter	A.R. 558, 559, 560. O.P.R. 128. O.O. 34348- A-238, Oct. 19, '04.	To District Armament Officer.
Target practice, report by district ordnance officer of defects developed in materiel.	Letter	Foot Note Form 819.	To District Armament Officer. When defect may affect decision as to penalties assessed against company, duplicate copies should be forwarded with target practice reports for consideration of coast defense officer and Chief of Coast Artillery.

WHEN THE OCCASION ARISES (continued)

Subject or Occasion	Form	Authority	Remarks
Trotol, when interior of box of, is found wet.	Letter.	C.A.D.R. 934½.	To The Adjutant General of the Army.
Work, estimate of cost of, for other departments, before work is undertaken.	Letter. See sample, page 351.	Par. III, G.O. 50, '11.	One copy to representative of the department eventually chargeable with work through local staff officer concerned.
Work, statement of cost of, for other departments, after work is completed.	Letter. See sample, page 351.	Par. III, G.O. 50, '11.	One copy as above, and one to District Armament Officer.

PAPERS ORIGINATING IN, OR PASSING THROUGH, THE POST ORDNANCE OFFICE

ALSO ACTION BY THE POST ORDNANCE OFFICER ENJOINED BY ARMY REGULATIONS, ORDERS, AND CUSTOMS:

(*Study carefully all the notes on every form.*)

EVERY MONTH

Date	Subject or Occasion	Form	Authority	Remarks
1st	Time report for each machinist and helper, showing work performed in detail.	1219	Par. 24, Sec. IV, G. O. 62, '08.	To the Artillery District Ordnance Officer, with the post ordnance officer's signature bracketing days on which work was performed at his post, leaving space for the district ordnance officer to sign. First report for each enlisted helper must be accompanied by a copy of order placing him on duty.
			D.J.A.G.: Pay and allowances, IC 6 b, A.R. 169.	No extra duty pay allowed for helpers employed for periods of less than 10 days (80 hours).

EVERY MONTH (continued)

Date	Subject or Occasion	Form	Authority	Remarks
1st	Time card for 24th to last of preceding month for each civilian employee of the Ordnance Department.	2586	Par. III, G.O. 102, '09.	To the Artillery District Ordnance Officer, bracketing days on which work was performed at his post with name of post, and signing with proper change in the form.
9th	Time card for 1st to 8th of this month for each civilian employee of the Ordnance Department.	2586	Par. III, G. O. 102, '09.	To the Artillery District Ordnance Officer, bracketing days on which work was performed at his post with name of post, and signing with proper change in the form.
16th	Time card for 9th to 15th of this month for each civilian employee of the Ordnance Department.	2586	Par. III, G.O. 102, '09.	To the Artillery District Ordnance Officer, bracketing days on which work was performed at his post with name of post, and signing with proper change in the form.
	Memorandum of all incomplete property transactions of longer standing than 15 days.			Placed on ordnance officer's desk.
24th	Time card for 16th to 23rd of this month for each civilian employee of the Ordnance Department.	2586	Par. III, G.O. 102, '09.	To the Artillery District Ordnance Officer, bracketing days on which work was performed at his post with name of post, and signing with proper change in the form.
	Result of personal inspection of places where explosive is stored.	Letter	C.A.D.R. 889.	Oral report to post commander will generally be considered sufficient.

JANUARY

Date	Subject or Occasion	Form	Authority	Remarks
2nd	Statement of ammunition, fire control instruments, etc. Separate statements for post and each sub-post.	70	O.P.R. 225 as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance through the Artillery District Ordnance Officer.
	Quarterly requisition for blank books and forms, giving number and name.	Letter. Form 388 may be used.	O.P.R. 91. A.R. 1573 and 1593.	Directly to Chief of Ordnance by officer using forms. In Philippines, to Chief Ordnance Officer.
5th	Requisitions for annual and semi-annual allowances of district ordnance property. (Good administration requires that all necessities be covered by annual and semi-annual requisitions. April and October requisitions should be rare and limited to contingencies which could not be foreseen.)	388	O.P.R. 72*. O.P.R. 73*.	In duplicate, to the Chief Ordnance Officer of the Division, through the Artillery District Ordnance Officer.
			O.P.R. 74*. *As amended by G. O. 8, '11.	In duplicate, to the District Armament Officer, through the Artillery District Ordnance Officer. See notes on preparation of.
10th	Requisitions for annual and semi-annual allowances of post ordnance property.	386	O.P.R. 77, as amended by G.O. 9, '11.	In duplicate, to the Chief Ordnance Officer of the Division, through post commander.
20th	Semi-annual property return.	18, 19, 20, 24, 25.	O.P.R. 191 and 207. A.R. 1571.	One copy, with one copy of all vouchers directly to Chief of Ordnance. In Philippines, through Chief Ordnance Officer.
21st	Check list of copies of all confidential records emanating from post ordnance office.		Par. X, G.O. 3, '12.	

JANUARY (continued)

Date	Subject or Occasion	Form	Authority	Remarks
2nd	Check the condition of emplacement books.		C.A.M. 7, '10.	Initial all entries made under your supervision.

FEBRUARY

1st	Requisition for explosives and artillery ammunition. (Should anticipate the need sufficiently to allow the most economical means of transportation.)	388	O.P.R. 72, as amended by G.O. 8, '11.	Annual artillery ammunition allowance order is usually published in time to reach posts about Feb. 1st.
			O.P.R. 92.	In duplicate, through post commander to Artillery District Ordnance Officer.
	Requisition for small arms and saluting gun ammunition. (Should anticipate the need sufficiently to allow the most economical means of transportation.)	386	O.P.R. 77, as amended by G.O. 9, '11.	In duplicate, Chief Ordnance Officer of Division, through post commander.
			O.P.R. 92.	

MARCH

10th	Request for memorandum of all repairs, spare parts, etc., needed for maintenance during next quarter.	Mimeographed letter. See sample, page 349.		To all parties who hold district ordnance property on memorandum receipt.
			O.P.R. 126. A.R. 1546.	Property other than that on the district return is not authorized to be transferred on memorandum invoice and receipt.
20th	Settlement of *all* memorandum receipts.			

APRIL

Date	Subject or Occasion	Form	Authority	Remarks
1st	Statement of ammunition, fire control instruments, etc. Separate statements for post and each sub-post.	70	O.P.R. 225, as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance through the Artillery District Ordnance Officer.
	Quarterly requisition for blank books and forms, giving number and name.	Letter. Form 388 may be used.	O.P.R. 91. A.R. 1573 and 1593.	Directly to Chief of Ordnance by officer using forms. In Philippines, to Chief Ordnance Officer.
5th	Requisitions for district ordnance property. (Good administration requires that all necessities be covered by annual and semi-annual requisitions. April and October requisitions should be rare and limited to contingencies which could not be foreseen.)	388	O.P.R. 72*. O.P.R. 73*.	In duplicate, to the Chief Ordnance Officer of the Division, through the Artillery District Ordnance Officer.
			O.P.R. 74*. *As amended by G.O. 8, '11.	In duplicate, to the District Armament Officer, through the Artillery District Ordnance Officer. See notes on preparation of.
10th	Requisitions for post ordnance property.	386	O.P.R. 77, as amended by G.O. 9, '11.	In duplicate, to Chief Ordnance Officer of Division, through post commander.

MAY

Date	Subject or Occasion	Form	Authority	Remarks
1st	Check the condition of emplacement books.		C.A.M. 7, '10.	Initial all entries made under your supervision.

JUNE

Date	Subject or Occasion	Form	Authority	Remarks
10th	Request for memorandum of all repairs, spare parts, etc., needed for maintenance during next quarter.	Mimeographed letter. See sample, page 349.	O.P.R. 126. A.R. 1546.	To all parties who hold district ordnance property on memorandum receipt. Property other than that on the district return is not authorized to be transferred on memorandum receipt and invoice.
16th	Blank certificates of inventory of artillery ammunition for end of accounting period.	See sample, page 349.	O.P.R. 209.	One copy to each responsible officer for necessary inventory and return by last day of month.
20th	Settlement of *all* memorandum receipts.			
30th	Certificates of inventory of artillery ammunition by all responsible officers in post.	See sample, page 349.	O.P.R. 209.	To Artillery District Ordnance Officer.

JULY

1st	(Same as for January 2nd.)			
5th	(Same as for January 5th.)			
10th	(Same as for January 10th.)			
20th	(Same as for January 20th.)			

SEPTEMBER

(Same as for March)

OCTOBER

Date	Subject or Occasion	Form	Authority	Remarks
1st	(Same as for April 1st.)			
5th	(Same as for April 5th.)			
10th	(Same as for April 10th.)			
11th	(Same as for January 22nd.)			

DECEMBER

Date	Subject or Occasion	Form	Authority	Remarks
10th	(Same as for June 10th.)			
16th	(Same as for June 16th.)			
20th	(Same as for January 22nd.)			
31st	Certificates of inventory of artillery ammunition by all responsible officers in post.	See sample, page 349.	O.P.R. 209.	To Artillery District Ordnance Officer.
	Personal report rendered by each ordnance sergeant.	1519 A.G.O.	A.R. 100.	Ordnance officer indorses his opinion of the manner in which the ordnance sergeant has performed his duty and forwards each report through the commanding officer directly to The Adjutant General of The Army.

WHEN THE OCCASION ARISES

(Same as for the District Ordnance Officer)

SAMPLES OF MIMEOGRAPHED CIRCULARS, CERTIFICATES OF INVENTORY OF ARTILLERY AMMUNITION, ETC.,

designed to reduce typewriting, as reminders to the persons to whom sent, to facilitate their reply, and to insure all sheets being of the standard letter size used in the service. Underlined portions indicate the blanks in the form before filling in.

Office of the Ordnance Officer,
FORT STEVENS, OREGON,
March 10, 1913.

From: The Ordnance Officer.

To: The Artillery Engineer, Fort Stevens, Oregon.

Subject: Request for informal memorandum of repairs, spare parts, etc., required.

In order to obviate the necessity for submitting requisitions more frequently than quarterly, it is requested that an informal pencil memorandum (on the back of this sheet if desired) be furnished this office relative to all spare parts, repairs, services of resident machinist, etc., which may be required for maintaining in efficient condition during the quarter beginning ...., the district ordnance property which you now hold upon memorandum receipt from this office.

....
1st Lieutenant, Coast Artillery Corps.

Certificate of Inventory

Artillery District of the Columbia.
FORT STEVENS, OREGON,
December 31, 1912.

I certify that, pursuant to par. 209, Ordnance Property Regulations, 1909, I have made a careful inventory of the artillery ammunition for which I am responsible, and that the memorandum receipt furnished by me shows the actual quantities of such ammunition on hand.

James I. Smith,
Captain, Coast Artillery Corps,
*Commanding Battery D. A. Russell.
*Ordnance Officer.

(*Cancel the office which does not apply.)

Artillery District of Chesapeake Bay,

OFFICE OF THE ORDNANCE OFFICER.

Report of progress of work at Fort Monroe, Virginia, during the month of

..................191..

A. O. No.	Gun Carriage etc.	Work completed prior to present m'th on No.	Work completed during present m'th on No.	Work in progress during present m'th on No.	Percent of total work done.

....

1st Lieut., Coast Artillery Corps,
Ordnance Officer.

Headquarters, Artillery District of the Columbia,

OFFICE OF THE ORDNANCE OFFICER,
Fort Stevens, Oregon,
October 1, 1912.

From: The Ordnance Officer.

To: The Armament Officer, Western District.

Subject: Fuel report for the quarter ending September 30, 1912.

The following quantities of fuel and power, supplied by 1st Lieutenant John Doe, C. A. C., ..., U. S. A., Quartermaster, Fort Stevens, Oregon, were consumed:

Kind	Quantity	Unit	Contract Price	Unit	Value
Coal		lb.	$ per	100 lb.	$
Charcoal	12	lb.	$0.011 per	1 lb.	$ 0.13
Gasolene		gal.	$ per	1 gal.	$
Kerosene	57	gal.	$0.098 per	1 gal.	$ 5.59
Electric power		Kw-hr.	$ per	1 Kw-hr.	$
				Total	$ 5.72

....

1st Lieut., Coast Artillery Corps.

HEADQUARTERS, ARTILLERY DISTRICT OF THE COLUMBIA,
OFFICE OF THE ORDNANCE OFFICER,
Fort Stevens, Oregon,
October 1, 1912.

From: The Ordnance Officer.

To: The District Engineer Officer, Portland, Oregon.
(Through The District Artillery Engineer, Fort Stevens, Oregon.)

Subject: [Estimate or] Statement of cost of repairing engine of 25 Kw. gas-motor set.

The [estimated or] actual cost of repairing engine of 25 Kw. gas-motor set at Fort Canby plant is found to be as follows:

For labor of ordnance machinist at $4.00 per day for 4⅝ days	$18.50
For labor of enlisted help at $.50 per day for 4⅝ days	$ 2.31
For materials as follows:	
14 inches of 1¼-inch cold rolled steel bar, price unknown	
22 inches of 1 by ⅜ inch rect. bar tool steel, price unknown	
Six filister head machine screws as per Astoria Hardware Co's bill	$ .08
Four ⅝ by 4 inch bolts, as per Astoria Hardware Co's bill	$ .14
Total	$

....

1st Lieut., Coast Artillery Corps.

Official copy furnished the Armament Officer, Western District, October 1, 1912.

....

1st Lieut., Coast Artillery Corps.

Note: Estimates are made in duplicate and the signature is typewritten in upper place of carbon copy only, by placing a loose sheet over the upper of the two forms to catch ribbon impression. Statements are made in triplicate and signature is typewritten in upper place on both carbon copies by the method used in the case of estimates. The original of the statement (the upper one of the three copies) is then removed from the machine and the lower signature typewritten on the under carbon copy only by using another loose sheet to catch the ribbon impression. The second copy when signed goes to the Armament Officer while the third copy is the file copy.

JANUARY

Date	Subject or Occasion	Form	Authority	Remarks
2nd	Statement of ammunition, fire control instruments, etc. Separate statements for post and each sub-post.	70	O.P.R. 225 as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance through the Artillery District Ordnance Officer.
	Quarterly requisition for blank books and forms, giving number and name.	Letter. Form 388 may be used.	O.P.R. 91. A.R. 1573 and 1593.	Directly to Chief of Ordnance by officer using forms. In Philippines, to Chief Ordnance Officer.
5th	Requisitions for annual and semi-annual allowances of district ordnance property. (Good administration requires that all necessities be covered by annual and semi-annual requisitions. April and October requisitions should be rare and limited to contingencies which could not be foreseen.)	388	O.P.R. 72*. O.P.R. 73*.	In duplicate, to the Chief Ordnance Officer of the Division, through the Artillery District Ordnance Officer.
			O.P.R. 74*. *As amended by G. O. 8, '11.	In duplicate, to the District Armament Officer, through the Artillery District Ordnance Officer. See notes on preparation of.
10th	Requisitions for annual and semi-annual allowances of post ordnance property.	386	O.P.R. 77, as amended by G.O. 9, '11.	In duplicate, to the Chief Ordnance Officer of the Division, through post commander.
20th	Semi-annual property return.	18, 19, 20, 24, 25.	O.P.R. 191 and 207. A.R. 1571.	One copy, with one copy of all vouchers directly to Chief of Ordnance. In Philippines, through Chief Ordnance Officer.
21st	Check list of copies of all confidential records emanating from post ordnance office.		Par. X, G.O. 3, '12.	

Since weapons govern tactics they first demand attention. Of the three—gun, ram, and torpedo—the first only can be dealt with in the time at my disposal. The end and object of the gun armament is to strike effective blows greater in number than those received. The most obvious way to do this is to bring into action a greater number of effective guns than the enemy. With this object short-range guns were mounted in ships and forts in two, three, or even four tiers. This is not necessary with long-range guns, which can be spread over a wide front, while the effect of their fire can be concentrated. To disperse the guns, while concentrating their effect, has been found to be an advantage in modern land battles, and armies have availed themselves of this power. Navies have not yet done so, but to this we must return later.

As was repeatedly proved during the sailing era, the tactical conditions required to facilitate frequent hitting are a constant range and relative bearing, which means that ships must steer on parallel courses, curved or straight, with their heads in the same direction. The introduction of steam made no change in this respect. The failure of the gun at the battle of Lissa was due, not to the use of armor, but to the neglect of these conditions. It was not given proper opportunity to hit. In an hour and a half the Austrian ironclads fired less than eight rounds per gun. The repulse of the *Formidabile* by the Madonna battery at San Giorgio showed how effective the gun could be at that time when the range and bearing were constant. Whatever the future may have in store, several actions during the Russo-Japanese war proved that the same conditions still held good at that time.

At what range ought we to be prepared to fight? At any range, since circumstances, or the enemy, may deprive us of any choice. We must neither be outranged at long distances, nor overwhelmed by a superior volume of fire at "decisive ranges." In the past this condition was satisfied by combining long guns and carronades in the armament of each ship. The primary armament of long-range guns was for distant firing, the secondary armament of short-range guns was to increase the effect producible by a given weight of armament at "decisive ranges." Started during the War of American Independence, the principle was maintained until the introduction of armor, *i.e.*, for a period of eighty years, of which twenty-eight were years of war. It was then discarded, was subsequently reintroduced, and is still a subject of controversy. Of its soundness in the past there can be no doubt. We have now to decide whether it is applicable to the present conditions. As to this we have to note that two 12-inch guns, with mountings and ammunition, may be taken to weigh rather more than three 9.2-inch or fifteen 6-inch guns. Also, that the relative rapidity of hitting with these natures under the gun-layer's test conditions may be taken as—1:2:3—and thus for a given weight of armament the relative hitting capacity would be—

2 of 850 lbs.; 6 of 380 lbs.; 45 of 100 lbs.

The smallest of the three would fall off at long ranges, but after making every allowance it would seem that at "decisive ranges" it should, like the carronade, give a better return for its weight than the heaviest. The battle practice results exhibit the smaller natures in such a favorable light that they confirm this view.

"Decisive range" may be defined as that distance at which one combatant develops in a limited time such a superiority of attack that the other is put out of action. From the "close alongside" of the Nelsonian era the

APRIL

Date	Subject or Occasion	Form	Authority	Remarks
1st	Statement of ammunition, fire control instruments, etc. Separate statements for post and each sub-post.	70	O.P.R. 225, as amended by A.G.O. 1781346, June 8, '11.	In duplicate, to Chief of Ordnance through the Artillery District Ordnance Officer.
	Quarterly requisition for blank books and forms, giving number and name.	Letter. Form 388 may be used.	O.P.R. 91. A.R. 1573 and 1593.	Directly to Chief of Ordnance by officer using forms. In Philippines, to Chief Ordnance Officer.
5th	Requisitions for district ordnance property. (Good administration requires that all necessities be covered by annual and semi-annual requisitions. April and October requisitions should be rare and limited to contingencies which could not be foreseen.)	388	O.P.R. 72*. O.P.R. 73*.	In duplicate, to the Chief Ordnance Officer of the Division, through the Artillery District Ordnance Officer.
			O.P.R. 74*. *As amended by G.O. 8, '11.	In duplicate, to the District Armament Officer, through the Artillery District Ordnance Officer. See notes on preparation of.
10th	Requisitions for post ordnance property.	386	O.P.R. 77, as amended by G.O. 9, '11.	In duplicate, to Chief Ordnance Officer of Division, through post commander.

MAY

1st	Check the condition of emplacement books.		C.A.M. 7, '10.	Initial all entries made under your supervision.

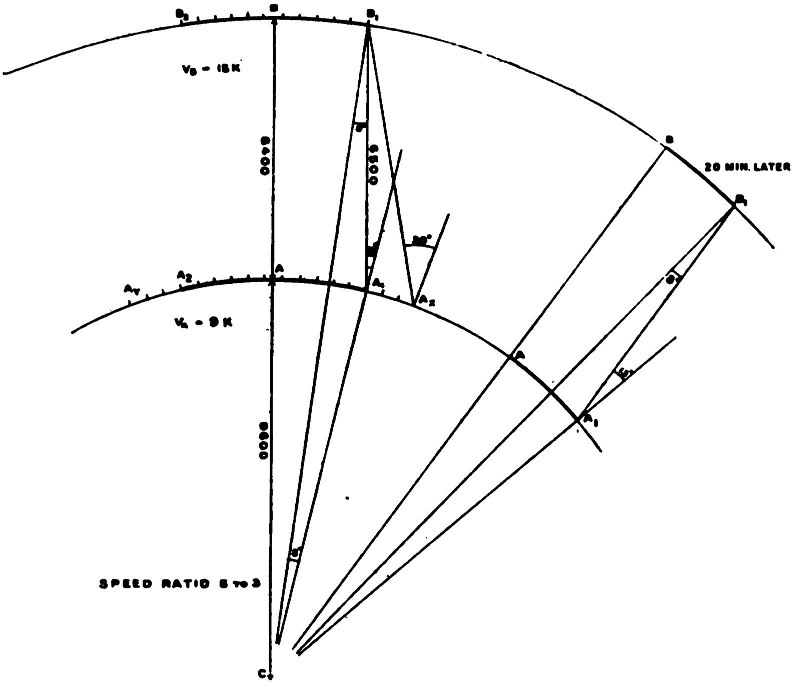


Fig. 1.

1216

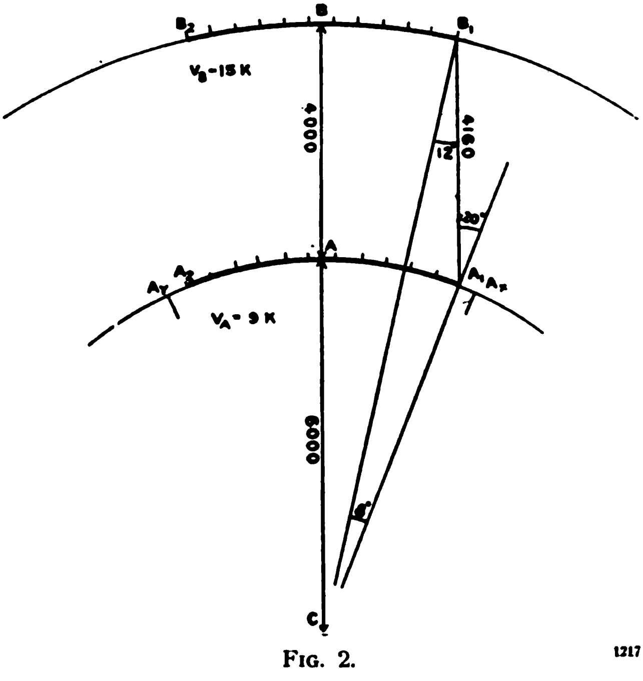


Fig. 2.

1217

their van; if they had turned less they would have opened, gone ahead in bearing, and not fought a decisive action.

The higher the curvature the smaller the fleets which can maintain tactical equality in this manner. As the lines close the curvature increases and throws the van and rear ships of the slow fleet out of action. At Tsu Shima, with twelve ships in each line, this would not have occurred until the range became less than 4000 yards. But the speed ratio, 5 to 3, in that battle was very high, and is not to be expected in future, since it means a difference of 10.6 knots, if the slow fleet steams 16 knots. For very small squadrons the speed ratio might possibly reach 4 to 3, but the curvature would be immaterial in their case. For fleets of any size the ratio will be perhaps 9 to 8, and more probably unity, which means that for present-day ranges, speeds, and differences the course may be taken as straight and the fleets unlimited in number by this consideration. Whether the speeds be equal or unequal, neither side can take position against his opponent's will on the bow of the other with all guns in action. The attempt can always be frustrated by standing on or by turning off. When two fleets once get into parallel lines, whether curved or straight, *i.e.*, into positions such as the two sides might have assumed at Tsu Shima, the only plan is to fight it out broadside to broadside. So long as there is plenty of sea-room, any practicable difference in the speeds is of little importance. If land or shoals impede free movement, scope will be given for tactical skill, and the result is as likely to accrue to the advantage of the one speed as of the other.

If future decisive battles are to be fought in parallel lines nearly straight, one important consequence follows. It will be possible to bring into action a larger number of ships carrying possibly a greater number of guns. Fig. 3 shows this number for various ranges, when the intervals between the ships are two cables and the gun arcs of training are 30° from the beam bearing. If the leaders remain abeam of each other and keep the range constant, A will be able to bring into action against B's rear extra ships—eight when the range is 6000 yards, increasing or decreasing by three for each addition or reduction of 2000 yards in the range. If the overlap is established at both ends, as might occur if B closed, the extra ships would be more numerous. We are content now to establish the proposition without reference to its possible consequences on design.

The importance of bringing a larger number of guns into action is seen by comparing the short time required to silence the enemy's guns at Kinburn in 1855, and at Fort Fisher in 1865, with the long time taken by the British Fleet at Alexandria in 1882, owing to the small number of guns carried, and to not giving those guns adequate opportunity to hit. In the battles between the Japanese and the Russians the former brought into action a greater number of guns. On August 10 the superiority was at first 63, and later 73, to 52, or about 40 per cent; at Ulsan it was 43 to 30, or about 43 per cent. At Tsu Shima it was 127 to 98, or nearly 30 per cent.

We turn to the accuracy of fire in battle. The facts at our disposal are neccessarily imperfect. At Lissa the Austrian ships received 412 hits, including those on masts and rigging. These are estimated to have represented perhaps 22 per cent of hits to rounds fired by the Italian ironclads. At Point Angamos the Chilians appear to have made 28 per cent. In both these actions, the ranges were very short. At the Yalu the Chinese 30.5 c.m. guns seem to have made 5 per cent; at Santiago the Americans made 3.2 per cent. During the Russo-Japanese war the percentages were:

	Russians.	Japanese.
Chemulpo........	*nil*	8-inch guns, 10.7, 6-inch and 4.7-inch. guns, 3.2.
August 10........	1	6 to 7.
Ulsan...........	less than 2	Not more than 6.

At Tsu Shima so many Russian ships were sunk that the percentages are not known; but were probably higher on both sides, as the leaders opened fire at 6400 yards, and the fight culminated at about 4500 yards, although continued at variable ranges, sometimes much greater and sometimes as short as 3000 yards or less. The percentages above-mentioned are very low, and show the need to keep the ranges not only constant but comparatively short.

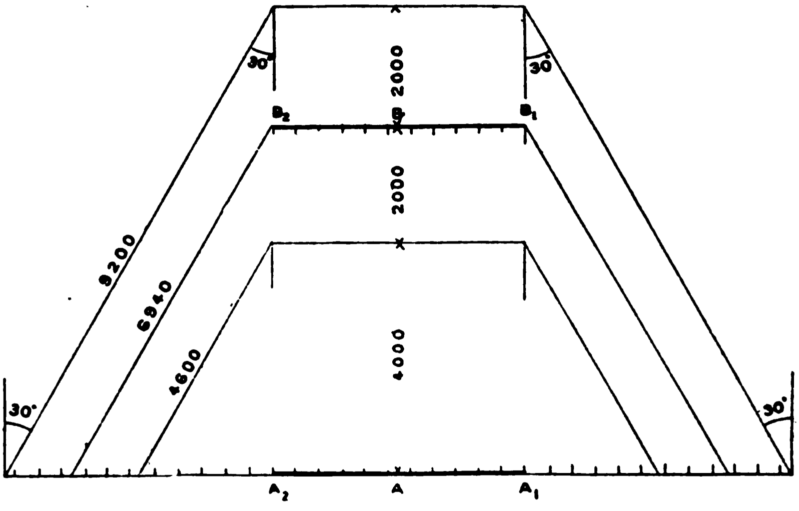


FIG. 3.

Attempts to counteract the errors inseparable from firing at sea at a ship in motion have been made in two different ways. The one method is to fire a large number of rounds, which involves a more or less numerous battery, and is associated with the idea of "decisive ranges"; the other method is to improve the accuracy, which has finally led to an increase in the size, and a reduction in the number, of the guns and to a leaning towards long ranges. Two different principles are here working in opposition instead of as mutual aids. The principle of numbers has been relied on in past wars, which have shown that, if one side is determined, decisive action cannot be avoided by the other, except by withdrawing. The principle of accuracy in its present development is a peace product, and is based on the idea that one side can always control the range against the will of the other, which is not true. The peace-tried principle of accuracy tends to undermine and destroy the war-tried principle of numbers. Is it wise or safe to push this tendency too far either by unduly increasing the size and reducing the number of the guns, or by over-centralizing the control? A striking fact bearing on this point is that the 6-inch gun is less accurate—has a lower percentage of hits to rounds—than the 12-inch gun at long ranges, but hits more often because it fires faster.

Turning to the effect produced by the gun fire. In the Russo-Japanese battles we find that one-half the hits, whether 12-inch or 6-inch, produced neither casualties among the *personnel* nor any material reduction in the fighting efficiency of the ships. The experience at Ulsan and Tsu Shima seems to indicate that, although the fight might culminate earlier, upwards of one hundred hits by high explosive shells from the guns used at that date were required to complete the defeat of a ship of the line. Both the inaccuracy of the shooting and the large number of hits required point to the need to fire a large number of rounds before a decision can be reached, especially at long ranges.

At the Nebogatoff court-martial a constructor, who had been present on board the *Orel* during the battle of Tsu Shima, stated that his ship was struck by forty-two 12-inch shells, and that fifteen of these hit within a period of twenty minutes towards the end of the day. Comparing the effect produced by 12-inch and 6-inch shell, known to have burst, we find that at Tsu Shima eleven 12-inch are said to have averaged 13 casualties, while eight 6-inch yielded 7 each, as against 12 and 13 respectively for a less number of each on August 10. In the first named action all the shells are believed to have been high explosive; in the last named there is some doubt as to whether all were so charged. The figures must not be pressed for more than they are worth: they point to the necessity for caution in accepting current doctrines and to the need for inquiry; they seem to indicate that the larger gun has been unduly magnified in the recent past. In a peace experiment the shell is usually made to hit exactly on the right spot. The difficulty of placing it there in battle is forgotten. Men shake their heads at the awe-inspiring sight of the effect produced by the large shell, and pass by that due to the small one. They forget that the most effective way to beat the enemy is to disable his *personnel* and to silence his guns. The war facts quoted seem to indicate that the smaller gun is by no means to be neglected as an instrument for this purpose. The effect produced depends not only on the size of the projectile, but on the place where it hits. An 8-inch shell disabled upwards of seventy men in the *Iwate* at Ulsan, and a six-pounder disabled a 10-inch gun on board the *Peresvyet* on August 10. A small shell on the right spot is more effective than a large shell on the wrong one, but to discover and much more to hit the right spot in action is difficult. Again, the facts show that it is a mistake to compare the gun-power of ships by the total weights of their respective broadsides. To do so is to assume that on the average an 850 lbs. 12-inch shell will damage the fighting efficiency of the ship as much as will eight 100 lbs. 6-inch. Such an assumption seems not to be true. When the guns in ships of the line were all about the same size the method was legitimate, but surely it is so no longer. Are not the numbers and sizes of the guns carried the best and only safe standard of comparison?

It is suggested that a ship of the line should be armed with two natures of guns, and that a careful balance should be maintained between the numbers and the sizes of both natures. On the one hand the numbers must provide a sufficient volume of fire at "decisive ranges," while the sizes must be such as will not only provide against being outranged at long distances, but will also maintain ascendency over the armor. The best armed fleet will be that which carries the largest numbers of the smallest guns which will do the work. This brings us to the question of armor.

TABLE 1.

The Elements of the Fighting Power of Typical Ships.

	French.						British.																				
	Algesiras 90.			Gloire 36.			Conqueror 101.			Warrior 40.			Sultan 12.			Dreadnought 4.			Inflexible 4.			Collingwood 10.			Majestic 16.		
	No. of guns.	Weight of shot.	Weight of shell bursters.	No. of guns.	Weight of shot.	Weight of shell bursters.	No. of guns.	Weight of shot.	Weight of shell bursters.	No. of guns.	Weight of shot.	Weight of shell bursters.	No. of guns.	Weight of shot.	Weight of shell bursters.	No. of guns.	Weight of shot.	Weight of shell bursters.	No. of guns.	Weight of shot.	Weight of shell bursters.	No. of guns.	Weight of shot.	Weight of shell bursters.	No. of guns.	Weight of shot.	Weight of shell bursters.
		lb.	lb.		lb.	lb.		lb.	lb.		lb.	lb.		lb.	lb.		lb.	lb.		lb.	lb.		lb.	lb.		lb.	lb.
Broadside	8	56	3.2	—	—	—	—	—	—	—	—	—	4	400	23.5	4	800	37.5	4	1700	75	4	714	31.5	4	850	80
	8	40	?	—	—	—	19	56	2.5	17	68	2.5	2	250	17	—	—	—	—	—	—	3	100	7.5	6	100	7.5
	18	33	1	18	90	3	31	32	1.25	2	90	6.25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	10	22	1	—	—	—	1	68	2.5	2	40	2.25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	1	99	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	45			18			51			21			6			4			4			7			10		
Relative firing capacity, i. e., number of rounds per minute	—	60	—	—	?	—	—	68	—	—	22	—	5 2.5	of of	400 250	—	2	—	—	1	—	2 of 714 7 of 100			5 of 850 36 of 100		— —
Area of target, armored	—	nil	—	—	⅓	—	—	nil	—	—	42 %	—	—	45 %	—	—	41 %	—	—	25 %	—	—	24 %	—	—	39 %	—
Crew	—	—	—	—	—	—	—	950	—	—	704	—	—	660	—	—	402	—	—	440	—	—	480	—	—	750	—
Displacement, tons	—	5240	—	—	5610	—	—	5400	—	—	9120	—	—	8700 as designed, 9300 as completed	—	—	10900	—	—	11880	—	—	9500 as completed	—	—	14900	—

The relative firing capacity, or the number of rounds that can be fired per minute, is based on the results obtained when single guns are firing at short known ranges. Reductions must be made when the whole broadside is firing at "decisive ranges."

ARMOR

Up to the middle of last century, men's only thought in battles at sea was to silence the enemy's fire. Then they began to look to armor for protection and safety, and ceased to place their trust in guns. This great change in principle is surprising, seeing how effective the latter had been, as proved by the winners' small losses compared with the losers' large ones in many actions at sea during the eighteenth and early nineteenth centuries, also in the attacks on Kinburn in 1855 and on Fort Fisher ten years later.

When armor was introduced armament was partially sacrificed, as can be seen by comparing the armored *Gloire* with the two-decker *Algesiras* (see Table II.). In the armored *Warrior*, which carried the same weight of armament as the two-decker *Conqueror*, the sacrifice was indirect, as that ship was made larger to carry the armor and to give increased speed. The two-deckers fired three shots for every one by the armored ships. It was assumed, and accepted without any adequate trial in battle, that the two-deckers' broadsides would be ineffective against the armored ships, although large parts of those ships were unprotected and the gun ports numerous. The tendency was to allot a smaller percentage of displacement to the armament, and to reduce the number of guns while increasing their size. In the *Dreadnought* of the early seventies the armor absorbed seven times as much weight as the guns, and the number of the latter was reduced to four. Her fire was so slow that she would have had some difficulty in hitting the enemy. Then began a reaction. In the early nineties the armor was to the guns as 3 to 1, in the year 1905 the proportion was 5 to 3 in battleships and 4 to 3 in the so-called "battle cruiser." The percentage of unprotected vertical target presented by sea-keeping vessels has ranged from about 30 in the *Gloire* and 40 in the *Warrior* up to as much as 75 in some ships since built.

When ships were completely clothed with armor, *e.g.*, American Monitors, its military effect was to reduce the "decisive range," as can be shown by comparing the action between the *Kearsarge* and *Alabama* with that between the *Weehawken* and *Atlanta.* In Mobile Bay Farragut showed that ships unarmored must close with those armored. On the same principle ships with thin armor must close with those having thick to give themselves a chance of victory. The action off Point Angamos, in which the *Huascar* was defeated, proved that armor is useless as soon as it is perforable. With the introduction of guns of great perforating power, and of ships only partially clothed, armor ceased to affect the "decisive range," which means that tactics are uninfluenced by armor.

If armor does not influence tactics, what is its military value? Some indication may be found in past naval actions. The unarmored ships *Hatteras*, *Alabama*, three out of the four Chinese ships destroyed at the Yalu, the *Varyag* at Chemulpo, the destroyers *Stereguschi* and *Strashni* were all beaten before their floating power and stability were destroyed, while the victors suffered small loss and damage. On the other hand, the *Novik* and *Tsu Shima* on August 10, 1904, and the *Kasagi* at the battle of Tsu Shima were each hit near the waterline, and obliged to haul out of action without any decision. At the beginning of the last-named battle, the Russian *Svyetlana* was hit below the waterline and her speed reduced to 15 knots.

TABLE II.

DISTRIBUTION OF THE WEIGHTS IN TYPICAL SHIPS.

	FRENCH.				BRITISH.													
	Algesiras.		Gloire.		Conqueror.		Warrior.		Sultan.		Dreadno'ht		Inflexible.		Collingw'd		Majestic.	
	Tons.	%	Tons.	%	Tons.	%	Tons.	%	Tons.	%	Tons.	%	Tons.	%	Tons.	%	Tons.	%
Hull	2450	46.8	2650	47.3	2942	54.5	4720	51.8	3750	43.2	3460	31.8	4310	36.0	3300	35.6	5850	39.3
Armament . . .	580	10.5	370	6.6	564	10.4	560	6.2	580	6.7	520	4.8	920	7.7	660	7.1	1580	10.6
Armor	—	—	810	14.4	—	—	1350	14.8	1740	20.0	3880	35.6	3400	28.3	2730	29.4	4540	30.5
Coal	600	11.4	650	11.6	524	9.7	700	7.6	600	6.9	1200	11.0	1200	10.0	950	10.2	900	6.0
Equipment, including motive mechanism or apparatus . . .	1640	31.3	1130	20.1	1370	25.4	1790	19.6	2020	23.2	1830	16.8	2150	18.0	1640	17.7	2030	13.6
Total	5240	—	5610	—	5400	—	9120	—	8690	—	10890	—	11980	—	9280 as designed, 9500 as completed		14900	—
									N. B.—460 tons of ballast were added.									

N. B.—The French and British figures are not directly comparable.

The armored *Huascar*, off Point Angamos, and the four spanish ships, off Santiago, were all defeated without compromising their floating power. This immunity was due to not being hit near the waterline, and not to armor. No vessel was sunk on August 10, 1904. At Ulsan the *Rurik* was completely beaten, the *Rossiya* and *Gromoboi* practically so, although their floating power had not been seriously compromised. At Tsu Shima the *Oslyaba* was beaten before she capsized; the *Suvorov* remained afloat and endured a tremendous battering at comparatively short ranges long after her fire was silenced; the *Alexander III.* and *Borodino* were probably beaten before they foundered; the *Orel* was beaten and surrendered, but her floating power remained unimpaired. The 8-inch waterline armor of the four last-named ships was perforable by the Japanese 12-inch guns at the ranges of the battle. May it be that the difficulty of hitting near the waterline explains why these ships remained afloat so long? The percentage of hits near the waterline to the total received has varied from 21 for the *Huascar* to about 10 for the Spanish ships at Santiago and for both sides on August 10, and to about 5 for the Austrian ships at Lissa and, perhaps, for the *Orel.* In none of the actions mentioned did the armored belts of the victors exercise any decisive influence on the results. Do not the facts tend to show that the risk to the flotation and stability has been somewhat overrated? As the ship need not be made absolutely unsinkable, but only sufficiently so to win victory, should not the difficulty of hitting the waterline be carefully considered before diverting large weights from guns—the most effective form of defence—to armor, which gives imperfect protection? In balancing the rival claims the naval architect will doubtless remember the great importance of good protection for the magazines and the value of horizontal armor.

Turning to the value of armor as a protection to guns. On August 10 the hits on the gun positions did not exceed 10 per cent of the total received. The vertical armor, which weighs nearly as much as the guns, mountings, and ammunition, saved only 25 per cent of the Russian, and none of the Japanese, primary gun positions from the effect of actual hits, while about 20 per cent of the primary guns on each side were out of action from various causes at the end of the day. At the battle of Tsu Shima the actual hits on the gun positions of the *Orel* were about 5 or 6 per cent of the total received by her. Although no armor was pierced, eight out of her twelve 6-inch and two out of her four 12-inch guns were silenced. On the Japanese gun positions the direct hits were at least 13 per cent of the total received. Of these known actual hits only 15 per cent were stopped by armor. Out of one hundred and twenty-seven Japanese guns of 6 inch and above, only six were put out of action by actual hits. Do not these facts indicate that it is difficult to make actual hits on the gun positions? Should we not remember this difficulty before deciding to give protection against actual hits—before diverting large weights from guns to "thick" armor? The word "thick" is used advisedly, because the losses sustained by the *Varyag* at Chemulpo, and by the Russian ships at Ulsan, seem to show that armor protection against fragments of bursting shell is absolutely necessary.

Guns, armor, and speed have hitherto been separately discussed. It may be well to conclude by bringing them together in a concrete form. Take two modern typical ships of the line, A and B, of about the same displacement, whose battle speeds may be taken as 17 and 22 knots respectively, and whose weights are distributed thus:—

	A Per cent of weight.	B Per cent of weight.	Per cent. Difference between B and A.
Hull	34.6	37.1	+2.5
Armor	28.0	19.2	—8.8
Machinery	11.5	19.3	+7.8
Coal	5.0	5.8	+0.8
Armament	17.3	14.7	—2.6
Equipment	3.6	3.9	+0.3
	100	100	

Weight has been transferred from armor and armament in A to the other elements in B to give increased speed, which, as has been shown, yields no adequate tactical, or strategical,* return. A's armor has no great fighting value, since it is limited in area to one-third of the vertical target presented, and is all easily perforable by the 12-inch gun up to 8000 yards, and as to three-fourths of it by the 9.2-inch gun up to 7000 yards and by the 12-inch up to extreme ranges. Thus, that given up by B may reasonably be held to be no real loss. That left to B, being thinner and perforable by the 9.2-inch gun up to 8000 yards, must confer even less fighting advantage, and might be even still more reduced if a gain could be shown in other directions. In fact, both ships carry weight—in the one case of armor, in the other of armor and machinery—which gives a doubtful return in battle. If this weight were not carried, they would be smaller and less costly, but for one obstacle —the armament.

The size of a ship depends largely on the length of the battery, which turns on the number, size, and disposition of the guns. Large guns in any number, especially when mounted on the centre line, mean a long, and therefore a large, ship. As has been shown, there is reason to doubt whether batteries of comparatively few large guns form the most effective armament. Any reduction in the size, or change in the disposition, of the guns will probably re-act on the size of the ship.

May it be that changes in the size, and distribution, of the guns in the direction indicated and the reduction to a minimum of armor—which is all now perforable—may check the growth in the size of ships and even reduce the present dimensions? To those reduced dimensions will correspond some most suitable speed, beyond which an increase will only be possible at the expense of fighting efficiency. A higher speed will only be obtainable either by reducing the armament of individual ships, while keeping their size, cost, and numbers constant, or by increasing their size and cost, but reducing their numbers. In either case the number of guns in the resulting fleet would be reduced. The ideal fleet of ships, reduced in dimensions and cost and of corresponding suitable speed, would be more numerous than existing fleets, which is an advantage within limits, and would carry more guns and more men, which are the essentials of victory. The additional number of men does not necessarily mean a greatly increased charge, but points to making arrangements for manning suitable to the new conditions.

---

* See "Naval Policy," by Barfleur.

The military principle advocated is the development of fire effect to the fullest extent possible. The decline in the value of armor and its possible reduction, coupled with the increased range and power of modern guns, are the changed conditions which may enable a return to be made to this old and well-tried principle.

—*Transactions of the Institution of Naval Architects*, Vol. LIV, 1912.

◆ ◆ ◆

FIRE CONTROL AND IDENTIFICATION OF SHIPS

By Lieut.-Colonel C. R. BUCKLE, D.S.O., R.G.A.

Fire control and identification of ships is a subject which has not yet received the attention which it deserves.

The reason is not far to seek. The ideal of the coast defense officer of the present day is to get his company classed as 1st class in Service Company Practice. The conditions under which Service Company Practice is carried out have little to do with fire control, fire direction, or other conditions which will prevail when batteries engage a hostile squadron.

So long as the greater part of the annual allowance of ammunition in expended in accordance with the minute directions which occupy thirteen and a half pages of "Instructions for Practice Seawards," which are framed with the vain (and in the writer's opinion mistaken) idea of making every coast defense unit in the British Empire carry out practice for classification under exactly similar conditions, we cannot expect Company Commanders to organize and train their companies to attain efficiency for war.

At first sight on perusing a copy of "Jane's List of Fighting Ships" one is appalled at the number of silhouettes which appear to be exactly alike, and the possibility of being able to identify a ship at a distance of 6 or 7 miles appears to be somewhat remote. But the problem is not nearly so difficult as it at first seems. We are not likely to be at war with every nation whose warships are represented in Jane's List at the same time. Our Intelligence Department will probably be able to reduce the list of ships which any one particular fortress is likely to have to engage to perhaps ten or a dozen classes.

Then again in the majority of cases we shall get some assistance from War Signal Stations and Port War Signal Stations.

It is really only as regards the choice of the projectile which we should use, and the portions of the ship which we are to attack that identification is necessary. It is the duty of every British or neutral warship when approaching a fortress to make known her identity. No blame attaches to a Battery Commander for firing on a warship which fails to do so.

A modern warship is so well protected that at the ranges at which an engagement is likely to commence the A.P. projectiles of a British Coast Defense Battery are quite unequal to penetrating her armor; the projectile we shall use will therefore almost invariably be H.E. shell, and our fire will be directed with a view to interfering with the gunfire of the ship rather than to attempting to penetrate her vitals. Exact identification for this purpose is not absolutely necessary.

Working on these lines instructions have recently been issued dividing vessels into 5 general classes, A to E, according to the powder and situation of their protective armor. But if the fire commander is able to identify the actual class to which a ship belongs, it is an advantage to inform the Battery Commanders, as they can then accurately determine the position of guns, conning tower, funnels, and the least protected portions of the ship.

This is praticularly necessary in the case of medium guns when dealing with ships of Class E; as a large number of the ships which are contained in this class are only open to attack by A.P. shell from medium guns at their two ends. It is necessary for the Battery Commander to look up the ship in Jane's List before he can determine whether to use H.E. or A.P. projectiles, and decide on what portion of the ship he should direct his fire.

A system which has been found to answer in peace maneuvers is to allot a number to each class of ship in every foreign navy. By this method when naming a ship in a telephone message, she would be described as American 1, or Japanese 2, or French 6, or German 10. The B.C. would have before him the classification list of the nation with which we were at war, and his target book or Jane's List would be marked with the corresponding numbers. To send the name of a ship in a telephone message takes up too much time.

The list below is that of the Russian Fleet:—

Class.	Name of Class.	Number of ship in Class.
1.	*Imperator Pave*	2
2.	*Slava*	1
3.	*Tsessarevitch*	1
4.		
5.	*Rurik*	1
6.	*Bayan*	3
7.	*Gromoboi*	1
8.	*Rossiya*	1
9.	*Askold*	1
10.	*Bogatyr*	4
11.	*Diana*	2
12.	*Jemtchug*	1
13.		
14.	*Ievstafi*	2
15.	*Pantelimon*	1
16.	*Rostislav*	1
17.	*Tri Svititelia*	1
18.	*Dvenadstat Apostolov*	1
19.	*Sinop*	2

The main considerations which should govern the distribution of fire of the batteries in a fire command is that of giving protection to the objective which the batteries are designed to protect. This objective may be a dockyard, naval stores, warships at anchor, or merchant vessels. It is desirable to keep every one of the attacking ships under fire, but those which are firing accurately on the objective which it is our duty to protect should receive the heaviest fire. The role of a coast defense fortress is to keep off the hostile vessels rather than to lead them on with a view to ultimately defeating them. Concentration of fire upon one ship whilst others in the squadron are left undisturbed to fire on the dockyard or on our warships is quite unsound.

On the other hand, if the attacking squadron bombards from a distance detaching a "spotting" ship to closer range to observe for the remainder of the squadron, this detached ship should be so smothered with bursting shell that spotting becomes impossible for her.

At the commencement of an action the Fire Commander will, as a rule, distribute his fire over the whole attacking squadron, perhaps allotting a few more guns to the leading, or flagship, than to the remainder of the squadron, but leaving no ship unfired on. As the action progresses it will be his duty to ascertain on what objective each hostile ship is directing her fire (this will be no easy task), and to so re-distribute the fire of the batteries as to give the maximum amount of protection to the objective which it is his duty to protect. If coast defense batteries can divert the fire of the attacking fleet from our warships or dockyard upon themselves, they are taking their proper place in the engagement in the same manner as our field artillery does when it diverts the fire of the opposing artillery from our infantry.

The system of fire control is closely connected with that of communication. The power which a Fire Commander possesses of controlling the fire of his batteries depends upon the rapidity and accuracy with which he can communicate with them.

There are certain principles which govern a good system of communications. They are:—

a. No unnecessary message should ever be sent.

b. No unnecessary word should ever be sent.

c. The recipient of the message and the operators at both the sending and receiving stations should be thoroughly familiar with the style of message and signification of all abbreviations which are employed.

The means of communication with which we are provided on the R.A. command lines of a fortress are the telephone, and signalling (morse and semaphore) in case the telephone breaks down. It is therefore all important that the method of dealing with telephone messages should be exactly similar to that of dealing with signalling messages.

A clear distinction should be made between ordinary routine or intelligence messages which do not require instantaneous action upon the part of the receiver, and fighting messages, in which latter case rapidity is of the utmost importance.

It is an advantage to a Battery Commander to know what other batteries are to engage the same ship as he is fighting. Now that we have switchboards in the fire commander's stations which enable us with the one operator to send the same message to all batteries in the fire command simultaneously (and this is a necessity for adequate fire control), we should always address our messages to the whole of our batteries in order that each Battery Commander may know what every other Battery Commander is doing.

The square system of indicating the objective which has for so long found a place in our Regulations is unworkable if the attack is made by more than one ship. It is hardly conceivable that one ship alone will attack a fortress; when an attack is made it will certainly be by a squadron of two or more ships, and they will be in some definite formation, *i.e.*—so close to one another that no one particular ship can be described by the square it is in. It will almost always be necessary to describe the ships as vessel 1, or vessel 2, or vessel 3, according to their position in the line. When ships are in column line ahead formation (the most probable fighting formation), there can be no doubt as to which is vessel 1, or vessel 2. In the improbable contingency of the squadron approaching in line abreast formation, the vessel on the right of the line would be described as vessel 1, that next to her as vessel 2, and so on.

"Garrison Artillery Training," Vol. I, on page 122, tells us that the Fire Commander will warn his battery commands by a message such as the following:—

"Expect attack squadron 15,000 N.E."

Surely the attack will either be entirely unexpected, in which case the Fire Commander's first intimation will be the sighting of warships, or else the Fire Commander will have received some definite information about the hostile squadron from one of the naval centers through his Fortress Commander giving the number of the ships, and possibly the class of ship, their position, speed, and course at some definite hour. Information as to the number and class of ships which are expected to attack should be sent to the Battery Commanders immediately it is received.

Elsewhere we read that the fire commander's next message may be one directing certain batteries to observe certain ships. This message would appear to be unnecessary. It should be a standing order that batteries are manned and that guns and range-finding instruments are directed upon any warship within range until such time as she has proved herself friendly or neutral. If the Fire Commander has made up his mind as to which batteries he will allot to each ship and the range at which he wishes them to open fire he should at once give his final fighting message directing fire to be opened at a certain range.

The wording of messages is of great importance, a definite system should be established in every fortress and strictly adhered to; Fire Commanders or their assistants and Battery Commanders should invariably write their messages themselves.

A system which has been found to work satisfactorily is as follows:—

The station call to each battery (usually two letters) is used in the address and signifies "Battery Commander....Battery." Batteries will range on the forward or after portion of the ship to which they are allotted according to the order in which they are named in the address of the message. Thus a message addressed GN. DG. means that GN battery directs fire forward and DG battery directs fire aft whilst ranging.

If three batteries are to engage the same ship, the first named battery ranges forward, the second named battery ranges aft, and then transfers fire forward, and as soon as the second named battery has fired its ranging rounds, the third named battery ranges aft.

There is a local standing order directing how many rounds are to be fired as ranging rounds under this system (say 4 per battery), and in case of two batteries having to range on the same part of a ship, the length of time (say 2 minutes) a battery is to wait before opening fire, if the battery named before it in the fighting message has failed to do so.

In the case of a vessel approaching the batteries so obliquely that she only presents sufficient breadth for one battery to range at a time, the abbreviation "RS" (sent as one word) and meaning "Range in succession" is added to the fighting message. In this case the first named battery fires 4 ranging rounds and ceases fire, then the second named battery does likewise, then the third named fires 4 ranging rounds; if there are only three batteries named, after the third battery has fired 4 rounds all three batteries continue fire.

The ships which batteries are to engage are shown in the address by dividing the names (station calls) of the batteries by a hyphen. Thus a message addressed "To GN. DG—TC. SB—PR. GL." signifies that GN battery will range forward and DG battery aft on vessel 1, TC battery will range forward and SB battery aft on vessel 2, PR battery will range forward and GL battery aft on vessel C.

If it is desired to allot three batteries to the leading vessel, two batteries to the second, and one to the third vessel, the message would be addressed thus—"To GN. DG. TC—SB. PR—GL." DG battery after firing 4 rounds aft on the leading vessel would transfer fire forward until TC battery had fired 4 rounds aft, when all three batteries would direct their fire on that portion of the ship the hitting of which will cause most interference with her gun fire.

If during the action a Battery Commander thinks that he is not hitting, but is not quite sure about it, he will alter his deflection so as to bring his projectiles clear of the ship altogether, or clear of that portion of the ship which is covered by the smoke of bursting shell fired from other batteries. He can thus verify his corrections.

The system will perhaps be made clearer by giving some typical messages:

Suppose the fortress to consist of six batteries, viz.: GN. DG. TC. SB. PR. GL.

The Fire Commander south at 6 a.m. on the 17th day of the month receives the following message from the Fortress Commander:

"To Fire Commander, South.

17th. Z.12. Newcastle reports that three Russian cruisers, class *Bogatyr*, were 40 miles east of Whitby at 4 a.m. steaming north-west at twelve knots.

From Fortress Commander."

Note. This message is not sent by the R.G.A., therefore the class of the vessels is given in full.

The Fire Commander at once sends the following message simultaneously to all six batteries by the one telephonist at the switchboard:—

"To GN. DG. TC. SB. PR. GL.

F.15. Three cruisers Russian 10 were 60 miles south-east at 4 a.m. steaming north-east at twelve knots.

From FC."

At 9 a.m. the Fire Commander makes out three vessels approaching from the south-east and identifies them as cruisers Russian 10 or *Bogatyr* class

He sends the following message:—

"To GN. DG. TC. SB. PR. GL.

F.16. The three cruisers 15,000 yards south-east are Russian 10.

From FC." "Urgent."

Assume that the hostile squadron is in column line ahead formation at two cables, and that on the course the squadron is steering, the vessels will come into the arcs of fire of four batteries, viz.: GN. TC. SB. and GL., but not into the arcs of fire of DG. and PR. until some time later.

The Fire Commander when he wishes his batteries to open fire will send the message:—

"To GN. TC.—SB.—GL.

F.17. Fate.

From FC." "Urgent."

Note.—Fate is the name of the Block in which the squadron is at the time the message is sent.

On receipt of this message GN. and TC. open fire on vessel 1, GN. ranging forward, TC. ranging aft, SB. opens fire on vessel 2, and GL. on vessel 3.

If the Fire Commander desired fire to be opened at any particular range say 10,000 yards, he would have worded his message thus:—

"To GN. TC.—SB.—GL.
F.17. Fate at 10,000.
From FC." "Urgent."

The Fire Commander would then inform DG. and PR. as to the objectives which the other four batteries are engaging by an ordinary message, there is no necessity to send this as an urgent message, thus:—

"To DG. PR.
F.18. GN. and TC. are engaging vessel 1, SB. is engaging vessel 2, and GL. vessel 3.
From FC."

Later on, when the hostile squadron is approaching the water area over which DG. and PR. batteries can fire, the Fire Commander decides to allot two batteries to each of the three ships and sends this message:—

"To GN. TC.—SB. GL.—DG. PR.
F.19. Fairy.
From FC." "Urgent."

Note.—Fairy is the name of the Block.

The effect of this message is to transfer the fire of GL. battery from the third ship to the second (no ranging rounds are necessary), and to direct the fire of DG. and PR. batteries on to the third ship, DG. ranging forward and PR. ranging aft.

Should the Fire Commander desire to concentrate the fire of all batteries on the leading ship he would send the following message:—

"To GN. DG. TC. SB. PR. GL.
F.20. Vessel 1.
From FC." "Urgent."

An ordinary telephone message is sent in exactly the same manner with the usual preamble, vide page 129, "Training Manual Signalling," 1907 (Reprint 1911), as a signalling message; but in the case of an urgent message, the procedure is as follows:—

The Fire Commander's telephonist as he obtains an acknowledgement from each of the stations he rings up, says "multiple message" "urgent," and names the station which is to repeat as the message is written down. The telephonist at each receiving station calls out at once "urgent message" loud enough for the Battery Commander to hear. The Battery Commander orders "action" at once and listens to the message as the telephonist repeats it. The Battery Commander thus receives the message verbally at first and shortly after is handed a written copy. No preamble is sent by the Fire Commander's telephonist, but the number of words in the message are sent at the end of the message after "Vic. E."

The telephonist at the station which has been ordered to repeat keeps his pressel switch pressed down whilst repeating; the telephonists at all the other receiving stations release their pressel switch whilst taking the message in order that their Battery Commanders may hear the message as they call it out word by word as received, without interfering with the telephonists at other stations.

Take message F.17 for an example:—

The FC. telephonist, after ringing up each station concerned, says

"Multiple message urgent Toc C repeat."

"GN. Toc C. hyphen. Esses Beer. hyphen. GL. break. F.
fi. 17. ff. Z Fate Z break FC. Vic E. words ten."

The telephonist at TC. with pressel switch pressed down repeats the message word for word as he writes it down, other receiving telephonists do likewise but with pressel switches free. Thus each telephonist has heard the Fire Commander's telephonist send the message and the telephonist at TC. repeat it. They count the words, and if correct say "R.Don" as soon as the Fire Commander's telephonist calls the name of their station on completion of the message.

The system is quite simple, rapid and accurate. The writer has on several occasions seen batteries when working on this system open a correctly directed fire in less than a minute from the time at which the fighting message is handed to the telephonist at the Fire Commander's post.

Any system to be successful requires practice. The fire command communications should be manned at least twice a month. If possible batteries should be partially manned, at the same time subcaliber or blank ammunition being fired; but for practicing the communication part of the system the essentials are a Battery Commander and telephonist at each B.C. post, and a launch towing a combination of targets eachof which represents the bows of a hostile vessel.

Battle practice schemes often fail to be realistic by reason of a separate launch being employed to tow the targets which represent each hostile ship; on account of safety conditions a hostile squadron in attacking formation cannot be represented by targets towed by more than one launch. A combination of targets towed by one launch is a necessity; a suitable combination is long range targets to represent the bows of each ship with a float or high speed target 300 feet in rear of each to represent the stern, the distance between float or high speed and the next long range target being 50 or 100 feet. The combination is somewhat unwieldy, and masters of launches do not like towing it, but it is essential for practical training, and we should insist upon having it.

In conclusion, although it does not, strictly speaking, belong to the subject of this article, an example of the messages necessary for the admission of H.M. ships into defended ports may not be out of place. Without some pre-arranged system, delay and possibly disaster will occur.

A method which has been found to answer satisfactorily is as follows:—

The Fire Commander on receiving intimation from the Port War Signal Station that some particular British warship has complied with the Regulations on the subject, and requests permission to enter the Port, sends the following message:—

"To GN. DG. TC. SB. PR. GL.
F.21. H.M.S. Drake. Code. PA.
From FC."

The letter "P" is the abbreviation for "Has permission to enter Port." The letter "A" is the abbreviation for "Acknowledge the receipt of this message."

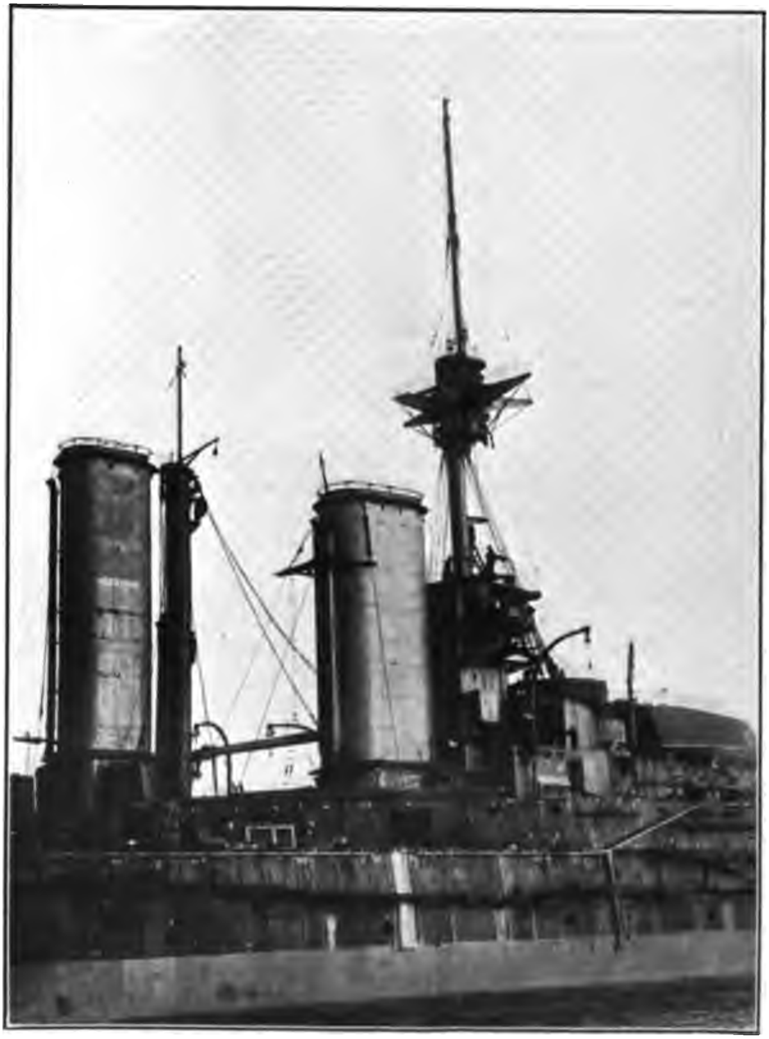
Each Battery Commander, after informing all concerned, himself writes and causes a message similar to the following to be sent:—

"To FC.
T.13. Your F.21 received.
From TC."

—*Journal of the Royal Artillery*, October, 1912.

H. M. S. KING GEORGE V.

In the *King George V.* the tripod mast has been abandoned. The control top, the bridge, and the conning tower may be clearly seen in the illustration.



Photograph by Stephen Cribb, Southsea. 1219

H. M. S. King George V.

The *King George V.* carries ten improved 13.5-inch guns, mounted two together in barbettes.

According to Jane (1912) the length of the ship is 564 feet and its displacement 25,000 tons; and according to *Engineering*, London, its beam is 89 feet and its torpedo-repelling guns 6 inches in caliber.

THE UTILIZATION OF AEROPLANES AND DIRIGIBLES FOR OBSERVATION OF FIRE OF COAST BATTERIES AND BATTLESHIPS

Translated from *Le Spectateur Militaire* of February 1st, 1912, by Major EDWARD P. SMITH., R.A., (Retired)

Each kind of air-craft has its own use on the sea.

Dirigibles would be employed for strategical reconnaissances, say in the Channel or Mediterranean, or to reconnoitre an enemy's island and report on his dispositions by wireless telegraphy.

Aeroplanes would be used for rapid scouting in a limited zone, for reporting on suspected buildings, or for watching the enemy's ports and coast defenses.

There is also one important duty common to both, that is the observation of fire.

Let us first consider the case of a coast battery engaging a hostile squadron. In clear weather dirigibles could mount 1300 to 1600 yards above the center of the enemy's line, thus offering the most difficult target. One could observe in comfort with the most powerful glasses, and report the result of the + rounds, which would be hidden from the battery by the target. The — rounds and those falling right or left would be seen from the battery.

An aeroplane on the other hand has to keep moving, and observation cannot be carried out with such comfort. Distant signals cannot be made, and owing to the weight of the equipment, wireless telegraphy cannot be used.

It would be best to use a swift, light monoplane, which would observe the first few rounds and return to the battery, dropping a packet with the results.

The battery could use signals with squares of red, white and blue bunting.

In considering the attack of a coast battery by a squadron, a dirigible could be used if the former is less than 550 miles from a French port. We do not allot to dirigibles at present a radius of action of more than 1100 miles.

The range of aerial wireless telegraphy is only 380 to 430 miles. In this case the aeronaut should observe the — rounds besides the +, as the former may fall behind a cliff, where the enemy's battery may be concealed.

In the case of a concealed target the commanding officer will give the general direction, and the dirigible will place itself above the trajectory and report results. He will correct the fire both for elevation and deflection.

He must have one set of signals for errors of range, and another for errors of direction.

Aeroplanes, whose useful radius extends to only 220 miles, must be kept on board ship, with buoys to enable them to float on the sea under favorable conditions. They must be prepared to be picked up by a ship, and to start off again from the deck when required. They must report the results of fire in the same way, and drop their sketches enclosed in a strong floating case. A long time must thus elapse between the observation and the correction of fire. For this reason an aeroplane is unsuitable for use from the opening of fire. Batteries must range by ordinary methods, and then aeroplanes must hover over the target and transmit their observations in the most suitable way.

In a strictly naval battle, the role of dirigibles will be confined to reporting whether the range is too long. If the wireless messages can be read by the enemy, the methods of signalling prescribed for the aeroplane must be used. This might be done by a light gun, which would discharge a floating case containing the reports.

To save time the following signal, which will be visible at long ranges, is recommended for aeroplanes:

To signal + rounds the aeronaut will make a "vol plane" of about 100 yards and then mount, thus forming the letter V.

A captive balloon can be used for observation of fire in the case of a squadron and a disembarking force acting against an enemy near the coast, as in the case of Maroc and Casablanca. The Italians used a military balloon at Tripoli. On November 9th, 1911, one saw above Tripoli the huge yellow sphere which directed the battle, and the air was furrowed by the cruisers' shells which were fired on the Turks over the heads of the Italian troops. The results were signalled by flags waved in a special way for + or —.

As regards the offensive use of air-craft, the Dirigible M_2 under General Lyncker threw a projectile of 110 lbs. on armored turrets. A sighting system like that for torpedoes would allow for the speed of the air-vessel. The projectiles would be fired from a large tube, of which the base would open on releasing a catch. Twenty of those rounds could be carried in an airship. These high explosives would pierce the decks of ships and cause great damage to the unarmored portions, and might even explode the boilers. The funnels and hatches are also vulnerable points, not impossible to hit.

Explosives of any useful size are too heavy to be carried on aeroplanes. An aeroplane might, however, cary a torpedo and inflict great damage on a ship from a height of 50 yards. It would be very difficult to bring it down.

At night dirigibles might give warning of torpedo attacks or of a squadron sailing without lights, or of ships trying to effect a blockade. Night reconnaissances, however, are more useful on land than on sea.

In the eastern manuevers the *Astra-Torres* left Belfort at night and flew above Vesoul, threw down a bag of despatches and re-entered Belfort unseen.

The *Adjutant-Reau* left Paris and remained aloft for 21 hours, covering nearly 1000 miles. It was not detected from Fort Verdun, despite the use of electric search-lights.

The raid of the *Adjutant-Vincenot* showed the possibility of keeping constant communication with the Eiffel Tower and keeping the Ministry informed of their operations, by the use of wireless telegraphy.

—*Journal of the Royal Artillery*, September, 1912.

◆ ◆ ◆

ALTITUDE OF SAFETY FOR AEROPLANES

Translated from the German by 2nd Lieutenant Arnold Heinrich, Coast Artillery Corps, for the Journal U. S. Artillery

When one considers the military use of airships, there at once arises the very important question, "What is the altitude of safety from fire?"

In this matter practical experience is almost wholly lacking. For although there have been occasions in the war in Tripoli when Italian aeronauts have been fired upon, yet on such occasions use has not been made of the most recent developments in fire arms designed for the attack of airships, while the Turkish soldier has been almost without training in that form of combat. So far as known, artillery fire has not been employed at all; only machine guns and small arms have been used.

No valuable conclusions can be drawn from the fact that in one instance an Italian aeronaut was wounded and compelled to make a hurried descent, for he was at a height of only nine hundred feet, while it is considered as unquestionable that aeroplanes at far greater altitudes have been reached by projectiles. What one is interested in knowing, is the minimum altitude at which an airship is safe from attack from the ground.

It may be assumed as beyond dispute that airships do not need, for safety, to ascend to an altitude as great as the maximum vertical fire of infantry, about 8000 feet. Indeed, at the last French airship maneuvers 4500 feet was specified; while an English authority on aeronautics, General Henderson, deems even 3000 feet sufficient for safety. And other experts on the subject consider the airship, because of its speed of from 90 to 100 kilometers an hour, such a difficult target as to be safe at half the altitude of maximum vertical fire, or about 4000 yards, which is practically the mean of the two opinions first quoted.

When considering artillery fire it must be remembered that the aeroplane has greater mobility than the field gun; and, according to the experts this is especially true because of the extreme elevation at which the gun must be employed. As a rule the airship will be out of range before the piece has fired its ranging shots.

On the other hand, the airship would be jeopardized by the aeronaut's getting, from time to time, more or less off his course without being aware of it; so a barograph, or an accurate, sensitive, and serviceable instrument for indicating altitudes, is essential to an airship's safety from infantry and artillery fire.

Also the aeronaut must be protected against what are known as "air-pockets"; for, if he cannot avoid that peril of air travel, his airship may make a considerable descent so suddenly and rapidly as to throw him out of his seat.

But no consideration must be allowed to deter the military aeronaut from venturing anything that may be necessary for the accomplishment of his purpose—reconnaissance. To fulfill his mission, he will, of course, when necessary, descend to heights at which he may be in danger of being shot down at any moment.—*Militar-Zeitung.*

Short Notes

The Coast Defenses of France.—The organization of the French coast defenses is a very complicated and rather inefficient affair. As stated before in these letters, the dual control by the army and navy is a source of weakness. One single department would suffice for the task, and the most logical measure would be to entrust the navy with the fighting of the enemy afloat. But that question of principle will be one difficult of settlement, and no doubt, for some time to come, the three departments—navy, ordnance, and engineering—will continue to share that important task.

This is not owing to a failure to seek a solution of the present situation. Last year, the chairman of the committe on naval affairs proposed to entrust that defense to a department to be created, the "Department of Coast Artillery," attached to the army, but specialized for the distinct service of coast ordnance. Such an organization exists in Germany; with the difference, however, that in Germany it is under the authority of the navy.

There is, then, at this time, nothing to be done except to let things remain as they are and to prop up the institution by making the necessary reforms and by increasing the cohesion of its diverse parts.

This is the task to which the minister is devoting himself. In the beginning of 1912, he caused some improvements to be made in the service of vigilance for the protection of the coasts of France, which, owing to its antiquity, was in great need of revision and correction. In order to concentrate the information service, he created both regional and central bureaus. In this way, and with the aid of wireless telegraphy and telephone, it will be comparatively easy to watch the plans of an adversary, and to assemble the necessary land and sea forces at the threatened points.

—*The Navy*, September, 1912.

Three-Gun Turret in the United States.—Rear Admiral N. C. Twining, Chief of the Bureau of Ordnance, announces that the three-gun turret for the new battleship *Nevada* has stood a satisfactory test at Indian Head, but he refuses to discuss this innovation in the construction of battleships. As the development of this new style of turret involves some very intricate problems which the Ordnance Bureau has solved, the Navy Department naturally is determined to keep the details secret until the work of installing the new turrets has actually been started. Although two nations have under process of construction or have authorized the construction of triple gun turret battleships none are in commission. None of the other nations is giving out their plans, but are working secretly on the problem. The efficiency and practicability of the new style of turret is questioned by naval authorities both in this country and abroad, and the Navy Department does not propose to give others the advantage of what we may learn in regard to this subject until it is absolutely necessary.

—*Army and Navy Journal*, October 26, 1912.

Three-Gun Turret in Italy.—The two battleships to be laid down this autumn for the Italian Navy will, it is understood, have a displacement of 30,000 tons and an armament of ten 15-inch and twenty 6-inch guns. They will resemble the American *Nevada* class in three important particulars —in the distribution of the main guns, in burning oil fuel exclusively, and in having only one smokestack. The speed is to be 25 knots.

There will be a three-gun turret forward and aft, and a twin turret mounted above and behind each. The shell fired by the 15-inch gun weighs 1650 pounds and carries a bursting charge of 88 lbs. The principal reason for its adoption is said to be that the velocity can be reduced—thus lengthening the life of the gun—without diminishing the hitting power. The 30,000-ton Japanese battleship *Fuso* will, it is believed, carry ten 15-inch and sixteen 6-inch guns.—*United Service Magazine*, September, 1912.

Three-Gun Turret in England.—We regard the three-gun turrets with a certain amount of suspicion, but of course, triple turrets are not popular in this country. For that matter, they appear to be equally unpopular in Germany, where some recent experiments are said to have shown that, in a given time, more rounds can be fired from a twin turret than from a triple one, as the men in a triple turret are in one another's way.

—Fred T. Jane, in *The Navy*, September, 1912.

The German Naval Airship L.1.—On the 17th of the month the first Zeppelin airship of the German navy was taken over by the Government. The *L.1.*, which has been constructed at Friedrichshafen under the supervision of Count Zeppelin, is about 525 feet long, 50 feet in diameter, and has a cubic capacity of 706,300 cubic feet; it has three Naybach motors, one in the front gondola and two in the back one, each with a capacity of 170 horse-power; the balloon consists of eighteen gas cells. The forward propellers, which are of aluminum, have two blades and the rear propellers four blades. The horizontal steering gear has six vertical surfaces and the elevation steering gear eight horizontal surfaces. An observation platform of sheet aluminum is erected on the top of the balloon, which is reached by means of a shaft. In the gangway between the two gondolas is a room for officers and men, in which wireless telegraphy apparatus is fitted up. Arrangements have been made for bomb-throwing in time of war. After a few trial trips of small extent made at the beginning of the month, the airship set out from Friedrichshafen on the 13th with twenty-one persons on board, among whom were the Government Examining Committee and Count Zeppelin, and after remaining in the air for thirty-one hours, landed at Johannisthal. The journey proceeded by way of Bielefeld to Norddeich, on the North Sea, and then eastwards *via* Heligoland, Kiel, Lubeck and Hamburg to Berlin, a total distance of about 1050 miles, the average speed being 33 or 34 miles an hour. The *L.1.* is stated to have successfully fulfilled all the requirements of the naval authorities.

—*The Engineer*, November 1, 1912.

American Aeroplanes.—The United States War Department have formulated their policy as regards the type of aeroplanes to be used in the army, and their employment. Type A, known as the "Speed Scout," is in future to be a one-seater, capable of not less than sixty-five miles per hour, with radius of action of one hundred miles. It is to be capable of ascending at the rate of 600 feet per minute. This type will be employed for rapid strategic reconnaissance, with a view to the location of large bodies of the enemy's troops. Type B, the "Scout," carries two men, who can relieve each other as pilot and observer. It must be capable of not less than forty-five miles per hour, and not more than sixty; it must be able to keep the air for three hours with a useful load of 450 lbs., and to ascend 2000 feet in ten minutes. This type is to be fitted with wireless. It will be used for the tactical reconnaissance, including the accurate location of small bodies of troops on the map, sketching the enemy's position, and taking photographs. This seems a sensible scheme, but it does not take into account the action of the enemy's aircraft. In air, as on land, a reconnaissance must be backed by force, and a third type, the *avion de combat*, will have to be developed to supply the necessary offensive power.

—*Army and Navy Gazette*, October 26, 1912

Protection from Aerial Attack.—That perfection which practice alone will bring, is gradually being acquired by persistent work on the part of the naval and military airmen of Britain, in the art of bomb-dropping. In all probability what is being done in this way here is also being done by air pilots in other countries. In fact we know that foreign aviators are making very good progress in bomb-dropping. Neither at home or abroad, however, has such skill been acquired in this new method of attack in war, on field and flood, to cause alarm; but sufficient progress has been made to show that it is time to think about providing against the danger that will eventually be present in a large degree at all points around our coasts and near our large arsenals, where ammunition is stored in magazines and tanks contain oil fuel for our war fleet. The turtle-back, armored, upper deck can be made to render all necessary protection to our warships, especially when the motor-driven ship is with us and smoke stacks are abolished. The warship will also be fitted with a suitable armament for counter attack on aircraft. Magazines and oil fuel storage can likewise be protected with tapering armored roofs of the necessary thickness, on which bombs would fall to explode without much injury or roll harmlessly to the ground. The war patrols which would be stationed at such spots could also be trained to work guns mounted for the purpose of firing overhead. But there is little time to lose now in providing this protection for the old depots, and arranging for the new works to be built bomb-proof by armored roofs, or placing them well under ground; and we commend the point to the attention of the authorities.—*United Service Gazette*, October 24, 1912.

Increasing England's Coastline Protection.—With commendable speed the Admiralty are shaping their ring-fence of aerial protection around our coasts. At Rosyth, at the Nore, at the premier and other naval ports, sites have been chosen, and in some instances the necessary buildings and plant are being established. But besides the main stations there will have to be an eye on every headland or other point of vantage where an airman and his machine can be stationed. The United Kingdom is rapidly being crinolined by an inner patrol of torpedo craft, submarine and surface, and an outer ring of first-class fighting ships; and now behind these are to come the new sea-eagles, whose eyes and wings will bring the information to set the other machinery in motion—for this will be the function of the aeroplane and the waterplane. Later on, no doubt, the cumbrous airship may find some useful place in the battle array; but at the moment her development has not advanced to a point at which as much attention to an airship, as to an aeroplane, is warranted—whatever surprises the future may have in store. Both the *Mayfly* and the *Gama*, as compared with the feats of both naval and military heavier-than-air machines, have shown that their movements aloft, and their mooring difficulties, prevent their full entry into a scheme of operations, either ashore or afloat, as reliable fighting machines. That the augmenting of our coast defense is to be one of the first uses to which aeroplanes will be put in this country is not surprising, seeing how splendidly adapted they are for that service, and the necessity that exists to make our coast defense as effective and complete as brain and invention permit.—*United Service Gazette*, October 10, 1912.

The Dictagraph.—A new device is under trial to enable reconnoitring and recording observations to be carried out by the pilot of an aeroplane,

without the necessity for carrying a passenger. As the pilot has both hands occupied, he cannot take notes; but he can speak into the mouth piece of a machine which records his words. This is the Dictagraph, the successor to the old-fashioned cumbrous phonograph; it is a small instrument which records spoken words on a miniature gramophone disc. It was at first attempted to mount the instrument on the steering wheel, but, as the vibration gave trouble, it is now carried on the pilot's back, with a tube and mouthpiece passing under his arm. The complete equipment includes a set of small parachutes, by which the discs can be safely dropped to a staff officer below.
—*Army and Navy Gazette*, August 31, 1912.

14-Inch Gun.—A 14-inch wire-wound gun and its disappearing carriage mount, of the types that are being constructed for the fortifications of Manila, Honolulu, and the Panama Canal, were successfully put through final tests at the Sandy Hook proving ground on November 4. These tests were to ascertain the rapidity with which the piece can be handled and fired, and six shots were fired in as rapid succession as it was possible for the gun crew to work. The six rounds were fired in 3 minutes and 45 seconds. Three consecutive shots of the six were fired in 1 minute and 30 seconds. The gun was trained at an elevation of 10 degrees, and the range was 12,500 yards. The variation of range of five of the six shots, with three different lots of powder used, was only 100 yards. The record as to rapidity was made notwithstanding the fact that some trouble was had with one of the powder bags of one of the rounds and the firing device misfired once. The powder charge weighs 320 pounds and the projectile 1660 pounds. The first five of the 14-inch guns laid down, among which is that tested, are 34 calibers long, and they have a muzzle velocity of 2150 feet, and the later ones designed are to have a length of 40 calibers and a muzzle velocity of 2250 feet.
—*Army and Navy Register*, November 9, 1912.

Eliminating Disturbing Noises from the Telephone.—According to the German periodical *Umschau*, a Swedish engineer named Saxenberg has invented, an effective device for eliminating, or at any rate greatly diminishing, adventitious noises in telephone conversation. The device consists of a variable water-resistance. One such apparatus is provided near each of the transmitters, and the person speaking can, by adjusting the electrodes in the water resistance, regulate conditions to such effect that secondary noises are reduced to a minimum.
—*Scientific American Supplement*, November 2, 1912.

French Powder.—Since the *Liberte* disaster, several minor accidents have occurred, due to the instability of the French powder. In the *Jules Michelet* a 6-inch cartridge exploded when being inserted into the breech, and a second explosion occurred during the same practice at another gun. Similar accidents occurred on the *Gloire*, several men being killed or wounded in each case. It has now been found that the amyl alcohol contained in the powder is liable to volatilize and take fire on contact with the heated walls of the powder chamber.—*Army and Navy Gazette*, October 19, 1912.

Method of Preventing Erosion.—The board of ordnance and fortification of the army has authorized J H. Brown to make arrangements for firing the fifty rounds yet to be fired in test of his method of preventing erosion by igniting the powder charge from the front end. Mr. Brown has advanced the theory that igniting the powder from the rear causes a wedging or jamming of the powder not yet ignited back of the projectile and that the gases of ignition rush by this wedge, causing part of the erosion noted in prior tests. His object is to overcome this. Many experiments have heretofore been made by the ordnance department by igniting the propelling charge at different points, but no marked difference in result has been noted.

—*Army and Navy Register*, October 19, 1912.

Protecting Iron and Steel from Corrosion. Anon. (*Brass World*, viii, 8, 272.)—Gilbert Rigg, of the New Jersey Zinc Company, has discovered that sodium tungstate prevents the rusting of iron and steel. A solution of 1 part of sodium tungstate in 2000 parts of water is efficient. This is applied to zinc oxide paints, and zinc tungstate is ground with the paint and protects iron and steel.

—*Journal of the Franklin Institute*, November, 1912.

NOTICES

MILITARY INVENTIONS

RECENT U. S. PATENTS OF MILITARY INTEREST

A complete copy of any patent here listed may be obtained of H. B. Willson & Co., Patent Attorneys, 715 Eighth St., N. W., Washington, D. C. Enquirers should indicate patent number and remit ten cents.

AERONAUTICS

1,039,117	Flying Tent, Emanuel Gerber, Kansas City, Mo.
1,039,228	Automatic Balancing Mechanism for Aeroplanes, J. L. Vogt, Long Green, Md., Assignor D. F. Mallory, Roland Park, Md., and I. O. Wright, Baltimore, Md.
1,039,295	Safety Device for Air-Craft, John Kratofill, Chicago, Ill.
1,039,476	Aerial Illuminating Mechanism, A. J. Austin, Los Angeles, Cal.
1,041,779	Combination Autoboat and Aeroplane, Felix Gregoire, St. Jean Baptiste, Manitoba, Canada.
1,041,876	Flying Machine, W. S. Romme, New York, N. Y., Assignor to McCormick-Romme Co., Chicago, Ill.
1,041,913	Aerial Propeller, Jas. R. Tyson, Reading, Pa.
1,041,916	Aerial Tramway, C. H. Vogel & G. R. Taitt, Vancouver, B. C. Canada.
1,041,942	Turbine Airship, T. H. Albert, Lodi, Cal.
1,042,082	Balancing Mechanism for Aeroplanes, Jos. Canty, Concord, N. H.
1,042,349	Airship Life-Preserver, L. I. Hill, Los Angeles, Cal.
1,040,089	Automatic Stabilizer for Aeroplanes, Eugene Yeamans, Collegeport, Tex.
1,040,136	Gyroplane, Nat. E. Brown, Grand Haven, Mich.
1,040,434	Aerial Vehicle Stabilizer, L. O. Schopp, St. Louis, Mo., Assignor to C. L. Schopp, St. Louis, Mo.

ARTILLERY

1,043,890	Recoil Checking Mechanism for Ordnance, Frank B. Yingling, Washington, D. C.
1,044,360	Method of and Means for Protecting the Bores of Heavy Guns from Erosion, Frederick N. Du Bois, New York, N. Y.
1,042,551	Recoil Mechanism, Ernest Gray, Ogden, Utah.
1,041,384	Gun Mounting, Karl Voller, Dusseldorf, Germany.
1,040,001	Breech-Loading Mechanism for Artillery Guns, Emil Olsson, Bofors, Sweden, Assignor to Aktiebolaget Bofors-Gullspang, Bofors, Sweden.
1,039,869	Gun having a Recoiling Barrel, Franz Wiedstruck, Koniggratz, Austria-Hungary, Assignor to Rheinische Metallwaaren und Maschinenfabrik, Dusseldorf-Derendorf, Germany.
1,042,048	Breech Mechanism for Guns, B. C. Snyder, Brooklyn, N. Y. and J. H. Torney, Washington, D. C., Assignors to G. E. Smouse, Washington, D. C.
1,041,248	Heavy Ordnance, A. T. Dawson, Westminister, London, England, and Jas. Horne, Barrow-in-Furness, England, Assignors to Vickers, Westminister, England.
1,041,249	Heavy Ordnance, A. T. Dawson, Westminister, London, England, and Jas. Horne, Barrow-in-Furness, England, Assignors to Vickers, Westminister, England.
1,041,250	Heavy Ordnance, A. T. Dawson, Westminister, London, England, and Jas. Horne, Barrow-in-Furness, England, Assignors to Vickers Ltd., Westminister, England.
1,042,135	Automatic Machine Gun, S. N. McClean, Cleveland, Ohio, Assignor to The Automatic Arms Co.
1,041,602	Heavy Ordnance, A. R. Dawson, Westminister, & Jas. Horne, Barrow-in-Furness, England, Assignors to Vickers Ltd., Westminister, London, England.

EXPLOSIVES

1,040,794	Perchlorate Explosive, Oswald Silberbrad, Buckhurst Hill, England.
1,040,793	Chlorate Explosive, Oswald Silberbrad, Buckhurst Hill, Eng.
1,041,745	Manufacture of Explosives, P. E. C. Corbin, Paris, France, Assignor to Societe Universelle d'Explosifs, (Anciennement: Berges, Corbin & Cie.), Paris, France.
1,042,643	Method for the Detonation of Explosives, Heinrich Brunsuig, Steglitz, near Berlin, Germany, Assignor to E. I. du Pont de Nemours Powder Company, Wilmington, Del.
1,042,830	Pressure-Fuse for Projectiles, Mines, Torpedoes, Etc., Ernst Sokolowski, Hamburg, Germany, Assignor to E. I. du Pont de Memours Powder Company, Wilmington, Del.
1,040,250	Primer for Cartridges, E. M. Funk, Mount Carmel, Conn., Assignor to Liberty Cartridge Co., Mount Carmel, Conn.

PROJECTILES, ETC.

1,039,459	Placing Containers in Projectiles, Ernst Sokolowski, Hamburg, Germany, Assignor to E. I. du Pont de Nemours Powder Company, Wilmington, Del.

1,043,074	Trajectory Regulator for Projectiles, Cleland Davis, U. S. Navy.
1,043,547	Projectile, Hy. Stanbridge, Sheffield, England, Assignor to J. A. Hill, Sheffield, England.
1,039,850	Artillery Projectiles, Karl Voller, Dusseldorf, Germany, Assignor to Rheinische Metallwaaren, und Maschinenfabrik, Dusseldorf-Derendorf, Germany.
1,040,924	Projectile, Ernest Frederick, U. S. Navy.
1,042,176	Artillery Projectile, Karl Voller, Dusseldorf, Germany.
1,042,504	Projectile, Robert A. Tute, Atlanta, Georgia.
1,039,774	Lubricating Projectile, A. W. Melander, San Francisco, Cal.
1,039,199	Explosive Projectile, Eugene Schneider, Le Creuzot, France.
1,039,204	Method of Placing Containers in Projectiles, Ernst Sokolowski, Hamburg, Germany, Assignor to E. I. du Pont de Nemours Powder Company, Wilmington, Del.
1,039,870	Burning Fuse for Projectiles, Karl Weiser, Bredeney, Germany, Assignor to Fried. Krupp Aktiengesellschaft, Essen-on-the-Ruhr, Germany.

SHIPS (NAVAL), ARMOR, ETC.

1,039,316	Method of Rendering the Joints of the Casemated Port-holes of Warships Water-tight, Max Noack, Friedenau, near Berlin, Germany.

SIGHTS, ETC.

1,040,161	Sighting Apparatus for Ordnance, A. T. Dawson and G. T. Buckham, Westminster, London, England, Assignor to Vickers, Limited.
1,040,162	Sighting Apparatus for Ordnance, A. T. Dawson and G. T. Buckham, Westminster, London, England, Assignor to Vickers, Limited.
1,043,678	Foresight for Small Arms, Rudolf De Bertouch, Kensington, London, England.
1,039,896	Rear Sight for Firearms, F. F. Burton, East Haven, Conn., Assignor to Winchester Repeating Arms Co., New Haven, Conn.
1,041,102	Gun Sighting Device, Heinrich Korrodi, Bern-Kirchenfeld, Switzerland, Assignor to Fried. Krupp, Aktiengesellschaft, Essen-on-the-Ruhr, Germany.

SMALL ARMS, TARGETS, ETC.

1,039,922	Self-Loading Pistol of the Kind Having Sliding Barrels, Rudolf Frommer, Budapest, Austria Hungary.
1,043,354	Magazine for Firearms, Jno. D. Pedersen, Jackson, Wyo.
1,043,670	Breech Block Mechanism for Firearms or Guns, A. D. Chronis, Dusseldorf, Germany, Assignor to Rheinische Metallwaaren-und Maschinenfabrik, Dusseldorf, Derendorf, Germany.
1,043,719	Electric Ignition Device for Small Arms, Gabriel Peuble, St. Etienne, France.
1,041,648	Firing Mechanism for Recoil Loading Pistols with Fixed Barrels, Paul Mauser, Oberndorf-on-the-Neckar, Germany.
1,041,258	Self-Scoring Target, M. St. C. Ellis, Boston, Mass.

1,041,365	Target Practice Apparatus, H. A. Stebbins, Malden & A. A. Adams, Brookline, Mass., Assignors to Atlantic National Bank, Providence, R. I.
1,040,503	Shot Gun Shell, William F. Brown, Minneapolis, Minn.
1,040,644	Breakdown Gun, Walton D. Davenport, Norwich, Conn.
1,042,363	Breech Loading and Discharge Actuated Firearm, S. N. McClean, Cleveland, Ohio, Assignor to The Automatic Arms Co.
1,039,182	Magazine Firearm, B. S. Parsons & W. A. Freeman, Harrisonville, Mo.
1,041,109	Magazine Gun, G. S. Lewis, Chicopee Falls, Mass., Assignor to J. Stevens Arms and Tool Co., Chicopee Falls, Mass.
1,039,232	Automatic Pistol, J. H. Wesson, Springfield, Mass., Assignor to Smith & Wesson, Inc.
1,041,839	Gun Barrel Cleaner, G. G. Miller, Lebanon, Pa., Assignor to Jos. Von Bracht, Reading, Pa.
1,042,007	Revolver, W. W. Key, Fayetteville, Ark.
1,039,839	Paper Shell Cartridge, C. H. Stevenson, New Haven, Conn., Assignor to Winchester Repeating Arms Co., New Haven, Conn.
1,042,837	Automatic Cartridge-Magazine for Firearms, Edmond Tatarek, Budapest, Austria-Hungary, Assignor to Johan von Benks, de Arkosi, Debreczen, Austria-Hungary.

SUBMARINE MINES AND TORPEDOES

1,039,254	Submarine Mine, C. P. J. Carteron, Sevran-Livry, France.
1,042,574	Floating Mine, Alexander Lernet, Vienna, Austria-Hungary.

MISCELLANEOUS

1,040,339	Motor Controlling Apparatus, J. D. Ihlder, New York, N. Y., and D. W. Lutz, Allendale, N. J., Assignors to Otis Elevator Co., Jersey City, N. J.
1,043,653	Gun Cleaner, Samuel Whollery, Brownfield, Penn.
1,040,210	Loading Device for Portable Guns, Alfred Kastner, Essen-on-the-Ruhr, Germany, Assignor to Fried. Krupp, Aktiengesellschaft, Essen-on-the-Ruhr, Germany.
1,040,047	Ammunition Hoist, Richard Star, U. S. Navy.
1,041,410	Cartridge Case Extractor, L. V. Benet & H. A. Mercie, Paris, France.
1,042,357	Rifle Trying Device, Joseph Livtschak, St. Petersburg, Russia.

◆ ◆ ◆

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The American Association for the Advancement of Science will hold its next convocation-week meeting in Cleveland, Ohio, from December 30, 1912, to January 4, 1913, under the presidency of Dr. Edward C. Pickering, Director of the Harvard College Observatory.

The annual meetings are usually attended by two thousand or more of scientific men and women and it is expected that the coming meeting will surpass previous meetings in the importance of its scientific program.

These meetings of the Association have been a clearing house to which men of science of the whole counrty have brought the results of their work, and from which they have returned with a renewed interest in research. The migratory meetings in widely separated places have extended an intelligent interest in science, and have led to a greater appeciation of its importance. An organization competent to represent the concensus of expert opinion has been an important factor in guiding the scientific activity of the country.

◆ ◆ ◆

BUREAU OF MINES' PUBLICATIONS FOR FREE DISTRIBUTION

We have been asked to print the following:

DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

New Publications

(List 13.—September, 1912.)

Bulletins

Bulletin 44. First national mine-safety demonstration, Pittsburgh, Pa., October 30 and 31, 1911, by H. M. Wilson and A. H. Fay. 1912. 75 pp., 8 pls.
Bulletin 47. Notes on mineral wastes, by C. L. Parsons. 1912. 44 pp.

Technical Papers

Technical Paper 22. Electrical symbols for mine maps, by H. H. Clark. 1912. 11 pp.
Technical Paper 24. Mine fires, a preliminary study, by G. S. Rice. 1912. 50 pp.
Technical Paper 26. Methods for the determination of the sulphur content of fuels, especially petroleum products, by I. C. Allen. 1912. 13 pp.

(List 14.—November, 1912.)

Bulletins

Bulletin 43. Comparative fuel values of gasoline and denatured alcohol in internal-combustion engines, by R. M. Strong and Lauson Stone. 1912. 243 pp. 3 pls.
Bulletin 46. An investigation of explosion-proof motors, by H. H. Clark. 1912. 44 pp. 6 pls.

Technical Papers

Technical Paper 25. Methods for the determination of water in petroleum and its products, by I. C. Allen and W. A. Jacobs. 1912. 13 pp.
Technical Paper 28. Ignition of gas by standard incandescent lamps, by H. H. Clark. 1912. 4 pp.

The Bureau of Mines has copies of these publications for free distribution, but can not give more than one copy of the same bulletin to one person, Requests for all papers can not be granted without satisfactory reason. In asking for publications please order them by number and title. Applications should be addressed to the Director of the Bureau of Mines, Washington, D.C.

CORRESPONDENCE

Any communication received by the Editor, which the writer desires inserted, which is signed by him and which would be of interest to the readers of the JOURNAL from a military point of view, will be published in this department. It is especially desired to have questions asked and small items of information given. Questions asked in one issue will be answered in the next, where possible, by some person, or persons, who is considered to be capable of giving authoritative information on the subject involved. Answers or remarks, regarding any such question by any others will always be very welcome. The readers of the JOURNAL (and others interested in it or its work) are most cordially invited to make full use of this department.

THE PROPER CALIBER FOR THE HIGH-POWER GUNS OF SEA-COAST BATTERIES

The Editor, Journal U. S. Artillery,
Fort Monroe, Virginia.

Sir:—

In Whole No. 114 (March-April, 1912) of your esteemed periodical, Captain G. A. Taylor, U. S. Army, presented the remarks that my colleague, Major de Vonderweid, had made relative to my study concerning the more convenient armament for coast batteries.

And since, in bringing those remarks to the attention of the many readers of the JOURNAL, he said that Major de Vonderweid had torn my arguments to pieces, I beg that Captain Taylor, with the same interest with which he has dealt with this important subject, may examine my answer to Major de Vonderweid as published by the *Rivista d'Artiglieria e Genio*, Vol. iv, November, 1911.

In that answer, Captain Taylor and his colleagues of the Coast Artillery may see whether, and how far, my critic had torn my arguments to pieces.

Trusting you will kindly publish this letter, I am, with best thanks and regards,

(Sgd) PAPPALARDO, V. F.
Capitano dell'Artiglieria Italiana.

Rome,
October 14, 1912.

Fort Howard, Marlyand,
November 6, 1912.

The Editor, Journal U. S. Artillery,
Fort Monroe, Virginia.

Sir:—

I take this opportunity to acknowledge the receipt of yours of the 2nd instant, inclosing a copy of Captain Pappalardo's letter. In answer I would say that I have glanced over Captain Pappalardo's reply to Major de Vonderweid, and note with pleasure that he quotes our Captain Gulick to some considerable extent. It would most assuredly be no more than justice to Captain Pappalardo to print at least a portion of his article. However, I can make no promises as to its being practicable for me to find the opportunity to make the translation. In fact it is simply a matter of time. Although it is not a long article, the work would of course have to be done at such times as would in no way interfere with my regular duties.

In my last translation I could but note the seeming asperity of the argument; but, of course, as a translator I would have no desire to become involved therein in any way. My opinion as to the value of Major de Vonderweid's arguments was simply that of an individual officer, and I trust that Captain Pappalardo did not take it too seriously. Indeed, if one did not become interested in a translation, the work would lapse into purposeless drudgery.

Respectfully yours,
G. A. Taylor,
Captain, Coast Artillery Corps.

BOOK REVIEWS

Report of the Chief Inspector of The Bureau for the Safe Transportation of Explosives and Other Dangerous Articles, February, 1912. By Lieutenant-Colonel B. W. Dunn, U. S. Army, Retired. New York: Bureau for the Safe Transportation of Explosives and Other Dangerous Articles. 7½x10½. 4 il. 3 plates. 104 pp. Paper. Price, 50 cents.

This report by Colonel B. W. Dunn, an officer of the army, recently of the Ordnance, now on the retired list, of international reputation as an expert in many different kinds of ordnance and ordnance machinery and accessories, deserves most careful study and consideration by all who are interested in the safe transportation of all kinds of explosive materials.

The report contains not only a full account of the work done by the Bureau during the past year, but has much other matter of interest, especially some very valuable data from tests of various explosive substances carried on in the chemical laboratory of the Bureau.

The value to the country at large of the work of inspection of explosives conducted under the direction of Colonel Dunn can hardly be estimated. In the few years that the Bureau has been at work it has become a regular practice of transportation companies to call for an inspection in every suspicious or doubtful case. For example, a leaking box of dynamite is now put aside and an inspector called to take or to recommend action; whereas formerly the unsafe condition would not have been noted, and the box would have been allowed to go forward. In the same way packages of explosives in storage magazines are very generally inspected nowadays, and the number condemned indicate the accidents that would probably have occurred if these unsafe explosvies had been allowed to get into the stream of traffic.

The report contains many instructive tables, but we desire to present here merely a few graphic comparisons:

In 1908, when the work of the Bureau practically began, the total number of boxes of high explosives condemned as unsafe for transportation was about 4850, whereas in 1911 it was nearly 6600; and the kegs of black powder condemned in the same way increased in that time from 531 to 1205, indicating the increasing work of inspection and the increasing interest in the subject by factories, storage magazines, and transportation companies.

The property loss due to accidents in transportation of explosives, has been reduced in a remarkable way; in fact, from nearly $500,000 in 1907 to less than $35,000 in 1911, and, of course, the establishment of this Bureau is responsible for the greater part of that reduction.

The Bureau has also supplemented its work of inspection by means of educational lectures for the purpose of teaching railway and other employees the necessity for the laws regulating the transportation, and to assist them in comprehending these laws. Over 400 lectures of this kind were delivered by Colonel Dunn and his assistants, during 1912, at all important railway centers in the United States and at 50 meetings of shippers and of railway and express employees.

The laboratory tests recorded in the volume include examinations of explosives, fireworks, inflammables, etc., and are exceedingly interesting not only to the practical manufacturer, but also to the scientific investigator.

The facts set forth in this report speak for themselves, and their language is strong praise of the splendid work of the Bureau.

The interest of the navy and the army in this subject is evident and needs no comment here; while the value of this report to transportation companies of all kinds, and especially to the rank and file of their employees, is so great that every man should be familiar with the main facts brought out in it, in order that every assistance in its good work may be given the Bureau, by each citizen of the land.

◆ ◆ ◆

Gunnery.—An Elementary Treatise, Including a Graphical Exposition of Field Artillery Fire. By Jennings C. Wise, B. S., Captain and Adjutant, 1st Battalion, Field Artillery, Virginia Volunteers. (Formerly 2nd Lieutenant, U. S. Army.) Richmond, Va.: B. F. Johnson Publishing Company. 6½" x 9½".

This is a series of lectures delivered by the author to the officers of the First Battalion Field Artillery, Virginia Volunteers, upon elementary mathematics, gunpowder and high explosives, ballistics, shrapnel, and practical gunnery. Seven chapters are devoted to practical gunnery as follows: Fire and Fire Data, Indirect Fire and Deflection, Range and Ranging, Angle of Site, Corrector, Observation of Fire, and Position and the Mask. The style of the book is clear and the explanations are generally very satisfactory.

As the author states in his preface, the book is not intended as a technical treatise, so a full and logical treatment of the subjects touched has not been attempted; the lectures, nevertheless, form a series of notes which will assist greatly in the instruction of the personnel of field batteries, especially in the organized militia; it is also a good introduction to the study of textbooks upon the various subjects covered by the lectures.

In a little introductory essay, which is full of interesting matter, the author discusses the "study and value of military theory." To this is added a well selected list of about eighty works of general military interest, mainly historical in character, beginning with the Macedonian Wars and ending with the Russo-Japanese War. It may be of interest to note that the author states that the cost of that little library would not exceed $300.

It is characteristic of the author's method that he deals in practical facts throughout his book, and gives little items of information here and there which are difficult to find elsewhere.

◆ ◆ ◆

Our Cavalry. By Major-General M. F. Rimington, C. O. V., C. B. New York: The Macmillan Company, 66 Fifth Avenue. 5¾" x 8¾". vii+224 pp. 8 diagrams. 1912. Cloth. Price, $1.60 net.

In his preface the author states that no attempt has been made to produce an exhaustive treatise on cavalry; but that he has written principally for junior officers of all arms. And though he has succeeded admirably in the task he set for himself, yet that he has at the same time prepared a book that is valuable to the cavalry as a special arm, appears from the contents.

The subjects of some of the twenty chapters are: armament; the horse; tactics; fire action; the cavalry brigade; cavalry in a campaign; horse artillery and cavalry; detached duties; raids; and the training of the officer, of the man, and of the horse.

In some 217 well-written pages the author has, in an interesting style, set forth his views on the use of cavalry in modern warfare. And one does not read far before ascertaining that the writer is master of his subject, taught in that best of schools—experience.

The author believes that *l'arme blanche*, knee to knee riding, and shock tactics are as applicable to-day as in the wars of Napoleon; and he gives much good advice for the employment of man and horse in such manner as to increase the fighting value of each.

Especially pertinent, though of general application, is the author's statement that "purely ameteur officers are poison (the virus being in direct proportion to their rank), and entirely out of place in war. To imagine that it is patriotism to wait till war begins, and then aspire to lead others, is an idea that should be crushed once for all. It is not patriotism, it is murder."

◆ ◆ ◆

Cours d'Artillerie a l'usage des eleves officiers de reserve, par le capitaine BIRAUD. Un volume in-8 etroit de 122 pages avec 76 figures. Paris: Berger-Levrault, editeurs, 5-7, rue des Beaux-Arts. Price 2 fr. 50.

This little book, very clear and exact, is intended for the use of student officers of the French reserve. The author, who for several years has taught this "Course in Artillery" at the seat of instruction, Poitiers, knows from experience what is to be expected of the desire to learn felt by young Frenchmen who, by their intellectual equipment and their general information, are fitted for the role of officers in war.

Captain Biraud's "Course in Artillery" is neither a purely technical work for the use of specialists, nor a loose and superficial essay: it is, properly speaking, a very complete and systematically arranged compendium of information relative to artillery which should be had by officers of reserve of all arms of the service.

The contents of the book are arranged in six divisions, the divisions being subdivided into short chapters, the number of chapters in a division varying from two to seven. The subjects treated in the six divisions are:

I. Powders and explosives;
II. Outline of ballistics;
III. Essential parts of cannon;
IV. Essential parts of carriages;
V. Ammunition;
VI. Fire effect.

An idea of the thoroughness of detail with which each division is treated may be had from the subjects of the chapters in Division III, which are as follows:

1. Classification of artillery and general information relative to artillery material;

2. Nomenclature of the piece;
3. Systems of fermeture;
4. Obturation;
5. Firing mechanism;
6. Interior forms of cannon;
7. Exterior forms of cannon.

The reviewer desires to add that he has found the little book, because of its elementary nature and explicit style, helpful, to one not a Frenchman, in acquiring a more precise knowledge of the shades of meaning of French technical terms.

◆ ◆ ◆

L. L. Poates & Co's. Complete Atlas of the World. New York: L. L. Poates Publishing Company. 6¾" x 9½". 193 pp. maps. 32 pp. index. 1912. Price, postpaid, cloth, $1.50; leather, $2.00.

This atlas is a most convenient one in size and weight, both of which, presumably, have been restricted for the purpose of making it the more suitable for its particular purpose. In size it is 9½ inches, by 6¾ inches; and its weight is about one pound and a quarter.

While the atlas is, in one sense, a complete atlas of the world, yet its arrangement as regards indexing justifies the statement that its relation to the larger atlases is that of the desk dictionary to the unabridged.

There is an alphabetical index of states and countries; another of counties in each state of the United States; a third of the principal cities and towns of each state; and a fourth of the important cities of the world outside of the United States.

Of the 193 pages of maps nearly all are of two pages; and incident thereto is the one defect observed in the volume, namely, that in many cases, though by no means in all, the details and the names near the line of junction of the two pages are read with difficulty. However, that is a defect which this atlas shares with practically all other double page atlases.

A very great convenience of the atlas consists in its including in the index of the principal cities and towns of each state of the Union, their populations according to the 1910 United States census.

The plates are new.

INDEX

TO

CURRENT MILITARY LITERATURE

Cumulated semi-annually, in last number of each volume.

PERIODICALS CITED

All the periodicals are preserved in the Library, Coast Artillery School, Fort Monroe, Va.

AUSTRIA.

A—1 Mitteilungen aus dem Gebiete des Seewesens. *Monthly*
Pola. *Per year 17 M*
A—2 Mitteilungen ueber Gegenstaende des Artillerie-und Genie-Wesens.
Getreidemarkt 9, *Monthly*
Wien VI. *Per year 20 M*
A—3 Streffleurs Militaerische Zeitschrift *Monthly*
zugleich Organ der militaerwissenschaftlichen Vereine.
I. Graben, 13. Wien. *Per year 28 M*
A—4 Zeitschrift des Oesterreichischen Ingenieur und Architekten Vereines.
Eschenbachgasse, No. 9. *Weekly*
Wien I. *Per year 34 K*

ENGLAND.

E—1 Arms and Explosives. *Monthly*
Effingham House, *Per year 7 s*
Arundel Street, Strand, London, W.C.
E—2 Army and Navy Gazette. *Weekly*
22 Essex Street, Strand, *Per year £1 12s 6d*
London, W.C.
E—2c Army Review, The. *Quarterly*
Wyman & Sons, Ltd. *Per copy, 1s*
Fetter Lane, London, E. C.
E—3 Canadian Military Gazette. *Semi-monthly*
Room 16, Trust Bldg., *Per year $2.50*
Ottawa, Canada.
E—3d Commonwealth Military Journal, The. *Monthly*
Melbourne, Australia.
E—3a Electrician, The. *Weekly*
1, 2 and 3, Salisbury Court, Fleet Street, *Per year 30s*
London, England.
E—3b Electrical Review. *Weekly*
4, Ludgate Hill, *Per year £1 10s*
London, E. C.

E—4	**Engineer, The.** *33 Norfolk Street, Strand,* *London, W.C.*	*Weekly* *Per year £1 16s*
E—5	**Engineering.** *35-36 Bedford Street, Strand,* *London, W.C.*	*Weekly* *Per year £1 16s*
E—6	**Iron & Coal Trades Review, The.** *165 Strand, London, W. C.*	*Weekly* *Per year 27s*
E—7	**Journal of the Royal Artillery.** *Woolwich, England.*	*Monthly* *Single copy 2s 6d*
E—7a	**Journal and Proceedings Royal Society N.S.W.** *5 Elizabeth St., North Sydney, N. S. W.*	
E—8	**Journal of the Royal United Service Institution.** *Whitehall, London, S.W.*	*Monthly* *Per year 24s*
E—9	**Journal of the United Service Institution of India.** *Simla, India.*	*Quarterly* *Per year $2.50*
E—9d	**Junior Institution of Engineers, The.** *39 Victoria St., Westminster, S.W.,* *London, England.*	*Single copy, 1s*
E—10a	**National Defence Magazine.** *15 Pall Mall, East, London, S. W.*	*Quarterly* *Single copy 2s 6d*
E—11	**Page's Weekly.** *22 Henrietta Street, Covent Garden,* *London, W.C.*	*Weekly* *Per year £1 5s*
E—12	**Photographic Journal.** *35 Russell Square, London.*	*Monthly* *Per year 12s*
E—12b	**Proceedings of the Institution of Civil Engineers.** *Great George St., Westminster, London, S.W., Eng.*	
E—13	**Proceedings of the Institution of Mechanical Engineers.** *Storey's Gate, St. Jame's Park, London, S. W.*	
E—14	**Royal Engineers Journal, The.** *Chatham, England.*	*Monthly* *Per year 16s*
E—16	**Transactions of the Canadian Institute.** *58 Richmond Street, Toronto, Canada.*	
E—17	**Transactions of the Canadian Society of Civil Engineers.** *Montreal, Canada.*	
E—18	**Transactions of the Institution of Naval Architects.** *5 Adelphi Terrace, London, W.C.*	
E—19	**United Service Gazette.** *43, 44 Temple Chambers.* *London, E.C.*	*Weekly* *Per year £1 10s 6d*
E—20	**United Service Magazine.** *22 Cockspur Street, Charing Cross,* *London, S. W.*	*Monthly.* *Per year £1 1s*

FRANCE.

F—0e	**Archives Militaires,** *Librairie Militaire Berger-Levrault,* *5-7 Rue des Beaux-Arts, Paris, France.*	*Quarterly,* *Per year, 14 fr.*

F— 0	**France Militaire, La** *10 Rue Danton, Paris.*	*Daily* *Per year 32 fr*
F— 1	**Genie Civil, Le** *6 Rue de la Chaussee d'Antin, Paris.*	*Weekly* *Per year 45 fr*
F— 1a	**Liste Navale Francaise.** *Quai Cronstadt, au coin de la Rue Neuve, Toulon, France.*	*Quarterly* *Per year 9 fr*
F—1b	**Journal des Sciences Militaires.** *30 Rue et Passage Dauphine (VI^e), Paris, France.*	*Semi-monthly* *Per Year 40 fr*
F— 2	**Memoires et Travaux de la Societe des Ingenieurs Civils.** *19 Rue Blanche, Paris.*	*Monthly* *Per year 36 fr*
F— 3	**Memorial des Poudres et Salpetres.** *55 Quai des Grands-Augustins, Paris.*	*Semi-annually* *Per year 13 fr*
F—3d	**Mois Scientifique et Industriel, Le.** *8, Rue Nouvelle, Paris, France.*	*Monthly* *Per year, $5.00*
F— 4	**Monde Militaire, Le** *6 Rue de la Chaise, Paris.*	*Fortnightly* *Per year 6 fr*
F— 5	**Revue d'Artillerie.** *5 Rue des Beaux-Arts, Paris.*	*Monthly.* *Per year 22 fr*
F— 6	**Revue de Cavalerie.** *5 Rue des Beaux-Arts, Paris.*	*Monthly, ex. Aug.* *Per year 27 fr*
F— 8	**Revue du Genie Militaire.** *5 Rue des Beaux-Arts, Paris.*	*Monthly* *Per year 27 fr*
F— 9	**Revue d'Infanterie.** *10 Rue Danton, Paris.*	*Monthly* *Per year 25 fr*
F—10	**Revue Maritime.** *30 Rue et Passage Dauphine, Paris.*	*Monthly* *Per year 36 fr*
F—11	**Revue Militaire des Armees Etrangeres.** *R. Chapelot et Cie., 30 Rue et Passage Dauphine, Paris.*	*Monthly* *Per year 15fr*
F—12	**Le Yacht—Journal de la Marine.** *55 Rue Chateaudun, Paris.*	*Weekly* *Per year 32 fr*

GERMANY.

G— 1	**Artilleristische Monatshefte.** *Mohrenstr. 19, Berlin, W. 8.*	*Monthly* *Per year 27 M*
G— 2	**Der Ingenieur.** *Cordel & Renne, Berlin W 15. Charlottenburg 4, 47 Fritschestr.*	*Semi-monthly* *Per year 14 M*
G— 3	**Eisen-Zeitung.** *Verlag von Otto Elsner, Berlin S. 42.*	*Weekly* *Per year 12 M*
G— 5	**Marine Rundschau.** *Koch Strasse, 68-71, Berlin, S. W.*	*Monthly* *Per year 8 M*
G— 6	**Militaer Wochenblatt.** With monthly Supplement. *Koch Strasse, 68, Berlin, S. W. 12.*	*3 times a week* *Per year 18 M*

G— 7	**Schiffbau.** *Zimmerstr., 9, Berlin, S. W., 68.*	*Semi-monthly* *Per year 20 M*
G— 8	**Stahl und Eisen.** *Düsseldorf 74, Breitstrasse 27*	*Weekly* *Per year 30 M*
G— 9	**Ueberall.** *Verlag: Boll und Pickardt,* *Berlin, N. W. 7*	*Monthly* *Per year 15.6 M*
G—10	**Zeitschrift fuer das Gesamte Schiess- und Sprengstoffwesen.** *J. F. Lehmann's Verlag, Munich.*	*Bi-monthly* *Per year 26 M*

ITALY.

I— 0c	**Rendiconti delle Esperienze e Degli Studi Esiguiti Nello Stabilimento di Esperienze e Costruzion Aeronautiche.** *Rome, Italy.*	*Bi-monthly* *Per year, 13.50L*
I— 1a	**Lista Navale Italiana.** *Rome, Italy.*	*Quarterly* *Per year 15 L*
I— 2	**Rivista di Artiglieria e Genio.** *Tipografia Enrico Voghera,* *Via Astalli 15, Rome.*	*Monthly* *Per year 20 L*
I— 3	**Rivista Marittima.** *Economo del Ministero della Marina,* *Rome.*	*Monthly* *Per year 25 L*

PORTUGAL.

P— 1	**Anais do Club Militar Naval.** *43 Rua do Carmo, Lisbon, Portugal.*	*Monthly* *Per year $3.85*
P— 2	**Revista de Artilharia.** *Rua do Carmo, 43, 2º, Lisbon.*	*Monthly* *Per year 12 fr*
P— 3	**Revista de Engenheria Militar.** *27 Rua Nova do Almada, Lisbon.*	*Monthly* *Per year 16 fr*
P— 4	**Revista Militar.** *Largo da Annunciada, 9, Lisbon.*	*Monthly* *Per year 2 2400 reis*

RUSSIA.

R— 3	**Imperial Nicholai War Academy Recorder, The.** *St. Petersburg, Russia.*	*Monthly* *Per year 6 rubles*

SCANDINAVIA AND DENMARK.

Sc— 1	**Artilleri-Tidsskrift.** *Artillerigarden, Stockholm, Sweden.*	*Bi-monthly* *Per year, U. S., 21.75*
Sc— 2	**Militaert Tidsskrift.** *Copenhagen, Denmark.*	*Semi-monthly* *Per year, U. S., 8 fr.*
Sc— 3	**Norsk Artilleri-Tidsskrift.** *Christiania, Norway.*	*Bi-monthly* *Per year, $1.50*
Sc— 4	**Norsk Militaert Tidsskrift.** *Christiania, Norway.*	*Monthly* *Per year, U. S., $2.50*

SPAIN.

Sp— 0b	**Informacion Militar del Extranjero.** *Madrid, Spain*	*Monthly*

Sp— 1 **Memorial de Artilleria.**	*Monthly*
Museo de Artilleria, Madrid.	*Per year, $3.50*
Sp— 2 **Revista Cientifico-Militar.**	*Semi-monthly*
Paseo de San Juan, 201, Barcelona.	*Per year 40 pesetes*
Sp— 3 **Revista General de Marina.**	*Monthly*
Ministerio de Marina, Madrid.	*Per year $4.45*

SWITZERLAND & BELGIUM.

S— 1 **Allgemeine Schweizerische Militaer-Zeitung.**	*Weekly*
Basel, Switzerland.	*Per year 10 fr*
S— 2 **Revue Militaire Suisse.**	*Monthly*
Avenue Juste Olivier, Lausanne,	*Per year 15 fr*
Switzerland.	
S— 3 **Schweizerische Monatschrift fuer Offiziere Aller Waffen.**	
Frauenfeld,	*Monthly*
Switzerland.	*Per year 6 fr*
S— 4 **Schweizerische Zeitschrift fuer Artillerie und Genie.**	*Monthly*
Frauenfeld, Switzerland.	*Per year 8 fr*
S— 5 **La Belgique Militaire.**	*Weekly*
Rue Albert de Latour 50,	*Per year 12 fr 50*
Schaerbeck, Brussels.	
S— 6 **Revue de l'Armee Belge.**	*Bi-monthly*
24 Rue des Guillemins, Liege, Belgium.	*Per year 13 fr*

UNITED STATES.

U.S.—0 **Aeronautics.**	*Monthly*
250 West 54th Street, New York City.	*Per year $3.00*
U.S.—0a **Flying and The Aero Club of America Bulletin.**	*Monthly*
297 Madison Ave., New York City.	*Per year, $3.00*
U.S.—0aL **American Historical Review.**	*Quarterly*
The Macmillan Company,	*Per yer $4.00*
41 N. Queen Street, Lancaster, Pa., or	
66 Fifth Avenue, New York City.	
U.S.—0dL **American Journal of International Law, The.**	*Quarterly*
Baker, Voorhis & Co., 45 John St., N.Y.	*Per year $5.00*
U.S.— 1 **American Journal of Mathematics.**	*Quarterly*
Johns Hopkins Press,	*Per year $5.00*
Baltimore, Md.	
U.S.— 2 **Arms and The Man.**	*Weekly*
1502 H Street, N.W., Washington, D. C.	*Per year $3.00*
U.S.— 3 **Army and Navy Journal.**	*Weekly*
20 Vesey Street, New York.	*Per year $6.00*
U.S.— 4 **Army and Navy Register.**	*Weekly*
Washington, D.C.	*Per year $3.00*
U.S.—4a **Bulletin of the American Geographical Society.**	*Monthly*
Broadway at 156th Street, New York City.	*Per year $5.00*
U.S.— 5 **Bulletin of the American Institute of Mining Engineers.**	*Monthy*
29 West 39th Street, New York.	*Per Year, $10.00*
U.S.— 6 **Bulletin of the American Mathematical Society.**	*Ten numbers per year*
501 West 116th Street, New York.	*Per year $5.00*

U.S.— 6a **Bulletins and Circulars of the Bureau of Standards.**	
Department of Commerce and Labor, Washington, D.C.	
U.S.—6aL **Bulletin of the Pan American Republics.**	*Monthly*
Washington, D. C.	*Per year $2.00*
	Monthly
U.S.— 6d **Bulletin, Iowa State College.**	
Ames, Iowa.	
U.S.— 7 **Bulletin of the University of Illinois.**	
Urbana, Illinois.	
U.S.—7b **Bulletins, Bureau of Mines.**	*Occasional*
Department of the Interior,	*Free*
Washington, D. C.	
U.S.—7cL **Canal Record.**	*Weekly*
Ancon, Canal Zone, Isthmus of Panama.	*Per copy, 5c*
U.S.— 8 **Cassier's Magazine.**	*Monthly*
12 West 31st Street, New York.	*Per year $3.00*
U.S.—8b **Compressed Air.**	*Monthly*
Compressed Air Magazine Co.	*Per year $1.50*
Easton, Pa.	
U.S.—8c **Confederate Veteran.**	*Monthly*
Nashville, Tenn.	*Per year $1.00*
U.S.— 8a **Craftsman, The.**	*Monthly*
41 W. 34th Street, N. Y.	*Per year $3.00*
U.S.— 9 **Electric Journal, The.**	*Monthly*
200 Ninth Street, Pittsburgh, Pa.	*Per year $1.50*
U.S.—10 **Electrical Review and Western Electrician.**	*Weekly*
Heisen Building,	*Per year $3.00*
608 South Dearborn Street, Chicago.	
U.S.—11 **Electrical World.**	*Weekly*
239 West 39th Street, New York.	*Per year $3.00*
U.S.—13 **Engineering Magazine, The.**	*Monthly*
140-142 Nassau Street, New York.	*Per year $3.00*
U.S.—15 **Engineering News.**	*Weekly*
505 Pearl Street, New York.	*Per year $5.00*
U.S.—16 **Engineering Record.**	*Weekly*
239 West 39th Street, New York.	*Per year $3.00*
U.S.—16d **Field Artillery Journal, The.**	*Quarterly*
U. S. Field Artillery Association,	*Per year, $4.00*
1701 Pennsylvania Avenue, N. W., Washington, D.C.	
U.S.—16a **General Electric Review.**	*Monthly.*
General Electric Company,	*Per year $2.00*
Schenectady, New York.	
U.S.—16b **Infantry Journal.**	*Bi-Monthly*
U. S. Infantry Association,	*Per year, $3.00*
814 Seventeeth Street, N. W., Washington, D. C.	
U.S.—19L **Journal American History.**	*Quarterly*
3 West 43rd Street, New York.	*Per year $3.00*
U.S.—20 **Journal American Society of Naval Engineers.**	*Quarterly*
Navy Department, Washington, D.C.	*Per year $5.00*
U.S.—21 **Journal of the Association of Engineering Societies.**	
31 Milk Street,	*Monthly*
Boston, Mass.	*Per year $3.00*

U.S.—22 **Journal of the Franklin Institute.**	*Monthly*
15 South Seventh Street, Philadelphia, Pa.	*Per year $5.00*
U.S.—22c **Journal of Industrial and Engineering Chemistry.**	
The American Chemical Society,	*Monthly*
Easton, Pa.	*Per year $6.00*
U.S.—23 **Journal of the Military Service Institution.**	*Bi-monthly*
Governors Island, New York.	*Per year $3.00*
U.S.—23a **Journal of the U. S. Artillery.**	*Bi-monthly*
Fort Monroe, Virginia.	*Per year $2.50*
U.S.—24 **Journal of the U.S. Cavalry Association.**	*Bi-monthly*
Fort Leavenworth, Kansas.	*Per year $2.50*
U.S.—26 **Journal of the Western Society of Engineers.**	*Monthly.*
1735 Monadnock Block,	*ex. July and August*
Chicago, Illinois.	*Per year $3.00*
U.S.—27 **Machinery.**	*Monthly*
49-55 Lafayette Street, New York.	*Per year $2.50*
U. S.—28a **Metal Industry, The.**	*Monthly*
99 John Street, New York.	*Per year $1.00*
U.S.—29 **Military Surgeon, The.**	*Monthly*
716 Union Trust Building, Washington, D. C.	*Per year $3.50*
U.S.—30 **Mines and Minerals.**	*Monthly*
Scranton, Penn.	*Per year $2.00*
U.S.—30L **National Geographic Magazine, The.**	*Monthly*
Hubbard Memorial Hall,	*Per year, $2.50*
Washington, D. C.	
U.S.—30a **National Guard Magazine, The.**	*Monthly*
136-140 East Gay Street,	*Per year $1.00*
Columbus, Ohio.	
U.S.—31 **Navy, The.**	*Monthly*
Southern Bldg., 15th and H Sts., N.W.,	*Per year $2.00*
Washington, D.C.	
U.S.—31d **Official Gazette of the United States Patent Office, The.**	
Supt. of Documents, Gov. Printing Office,	*Weekly*
Washington, D. C.	*Per year $5.00*
U.S.—31a **Pennsylvania Magazine of History and Biography.**	*Quarterly*
Philadelphia, Pa.	*Per year $3.00*
U.S.—32 **Physical Review.**	*Monthly*
41 North Queen Street, Lancaster, Pa.	*Per year $5.00*
U.S.—32a **Polytechnic, The.**	*10 numbers per year*
Troy, N. Y.	*Per year $2.00*
U.S.—33 **Popular Mechanics.**	*Monthly*
318 West Washington Street, Chicago, Ill.	*Per year $1.50*
U.S.—33a **Practical Electricity and Engineering.**	*Monthly*
608 South Dearborn Street, Chicago, Illinois.	*Per year $1.00*
U.S.—34L **Proceedings American Institute of Electrical Engineers.**	
33 West 39th Street,	*Monthly*
New York.	*Per year $10.00*
U.S.—35 **Proceedings of the American Philosophical Society.**	
104 South Fifth Street, Philadelphia, Pa.	
U.S.—36 **Proceedings of the American Society of Civil Engineers.**	
220 West 57th Street,	*Monthly*
New York.	*Per year $8.00*

U.S.—37 Proceedings American Society of Mechanical Engineers.
29 West 39th Street, *Monthly*
New York. *Per year $3.00*

U.S.—38 Proceedings of the Engineers' Club of Philadelphia.
1317 Spruce Street, *Quarterly*
Philadelphia, Pa. *Per Vol. $2.00*

U.S.—39 Proceedings of Engineers Society of Western Pennsylvania.
2511 Oliver Building, *10 numbers per year*
Pittsburg, Pa. *Per year $5.00*

U.S.—40 Proceedings of the U. S. Naval Institute. *Quarterly*
Annapolis, Md. *Per year $3.00*

U.S.—40a Professional Memoirs. *Bi-monthly*
Washington Barracks, D. C. *Per year $3.00*

U.S.—40b Reactions. *Quarterly*
Goldschmidt Thermit Company, *Per year $0.25*
90 West Street, New York City.

U.S.—41 Review of Reviews. *Monthly*
30 Irving Place, New York. *Per year $3.00*

U.S.—41b Science. *Weekly*
41 North Queen Street, Lancaster, Pa. *Per year, $5.00*

U.S.—41c Science Conspectus. *Five issues per year*
Massachusetts Institute of Technology, Boston, Mass.

U.S.—42 Scientific American, The. *Weekly*
361 Broadway, New York. *Per year $3.00*

U.S.—43L Scientific American Supplement. *Weekly*
361 Broadway, New York. *Per year $5.00*

U.S.—43d Scientific Digest, The. *Monthly*
Kansas City Life Building, *Per year $1.00*
Kansas City, Mo.

U.S.—44 Seventh Regiment Gazette, The. *Monthly*
30 West 33rd Street, New York. *Per year $1.50*

U.S.—44b Southern Electrician. *Monthly*
Cotton Publishing Co., Atlanta, Ga. *Two years, $1.00*

U.S.—44a Stevens Institute Indicator. *Quarterly*
Hoboken, N. J. *Per year $1.50*

U.S.—44d Technical World Magazine. *Monthly*
58th Street and Drexel Avenue, Chicago, Ill *Per year, $1.50*

U.S.—45a Telephone Engineer. *Monthly*
Monadnock Building, Chicago, Ill. *Per year, $2.00*

U.S.—46 Transactions of the American Society of Civil Engineers.
Quarterly
220 West 57th Street, New York. *Per year, $12.00*

U.S.—47 Transactions of the Society of Naval Architects and Marine Engineers.
29 West 39th Street, New York.

U.S.—47L Virginia Magazine of History and Biography, The.
Virginia Historical Scoiety, *Quarterly*
Richmond, Va. *Per year, $5.00*

MISCELLANEOUS.

M— 0 Boletim Mensal do Estado Maior do Exercito, *Monthly*
Rio de Janeiro, Brazil.

M— 1	**Boletin del Centro Naval.** *Florida 659, Buenos Aires, Argentine.*	*Bi-monthly* *Per year $m/n 11.90*
M— 1b	**Boletin de Ingenieros.** *War Dept., Mexico City, Mexico.*	*Monthly*
M— 2	**Boletin del Ministerio de Guerra y Marina.** *Apartado No. 91, Lima, Peru.*	*Fortnightly*
M—2b	**Memorial del Estado Mayor del Ejercito de Chile.** *Talleres del Estado Mayor-General.* *Santiago de Chile.*	*Monthly*
M—2d	**O Tiro.** *Rio de Janeiro, Brazil.*	*Bimonthly*
M—2a	**Proceedings and Year Book of the Association for Military Science.** *34 Maria Street, The Hague, Holland.*	
M— 3	**Revista del Ejercito y Marina.** *Departamento de Estado Mayor,* *City of Mexico.*	*Monthly*
M— 4	**Revista de Marina.** *Casilla del Correo 976, Valparaiso, Chile.*	*Monthly* *Per year $15.00*
M— 5	**Revista Maritima Brazileira.** *Rua D. Manoel n. 15,* *Rio de Janeiro, Brazil.*	*Monthly* *Per year $6.00*
M— 6	**Revista Militar.** *Paseo Colon, Buenos Aires, Argentine.*	*Monthly* *Per year $9m/n*

Synopsis of Index

As far as possible the entries of the Index are grouped according to the following synopsis:—

- Artillery Material,
    - coast,
    - field,
    - explosives,
    - projectiles,
    - general (including armor, etc.),
    - range finders,
    - sights, etc.,
- Automobiles,
  - Aerostation,
- Ballistics,
    - exterior,
    - interior,
    - penetration,
- Range Finding and Pointing,
    - position finding,
- Cavalry,
    - equipment,
    - mounts,
- Chemistry,
  - Photography,
- Drill Regulations,
  - Maneuvers,
  - Practice,
    - artillery, coast,
    - artillery, field,
    - cavalry, (practical training)
    - infantry, (practical training,
    - general,
    - naval,
- Electricity,
    - communications,
    - general,
    - light,
    - power,
    - storage batteries,
- Boilers,
  - Engines,
    - gas,
    - steam,
    - general,
- Mechanism, Mines, Torpedoes, etc.

(Continued on page 12.)

Index

[Periodicals from May 16, to November 15, 1912]

ARTILLERY MATERIAL

Coast:

Casemate 120 mm. guns and howitzers on carriages which completely close their embrasures—S-6, March-April, 12.
Guns of the coast-defense—US-42, May 18, 12.
Guns *versus* armor—US-42, May 18, 12.
Manufacture and treatment of steel for guns—E-5, May 17, 12.
A new type of powerful mortar—US-42, July 6, 12.
The proper caliber for the high-power guns of seacoast batteries—US-23a, May-June, 12.
Supercalibers from the point of view of construction—I-2, March, 12.
Suggestions for improvements in R. G. A. material—E-7, August, 12.
A new Krupp gun for ships—G-1, June, 12.

Field:

The Deport mountain gun—US-16d, April-June, 12.
The Deport field gun in Italy—US-16d, April-June, 12.
The field artillery—E-7, July, 12.
Heavy artillery of the line—I-2, February, 12.
High-angle-fire guns for the short-range struggle in siege warfare—F-8, May, 12.
Notes on French heavy field artillery—I-2, March, 12.
The progress of field artillery materiel—I-2, March, 12.
The question of the light field howitzer—E-7, July, 12.
The use of field artillery—US-23a, May-June, 12.
Artillery material of 1911 according to "Lobell's Jahres Berichte"—I-2, May, 12.
More ideas on artillery—F-1b, July 1, 5, 12.
Mountain guns—I-2, May, 12.
The question of the light howitzer—F-0, July 27, 12.
An adjustable range and elevation scale for ranging howitzers in yards—E-7, October, 12.
Bridge implements for the field artillery -S-4, October, 12.
Considerations relative the arming of the French field artillery—G-4, No. 9, 12.
The English 12.7 cm. gun -S-4, June, 12.
French artillery material in 1870 and its use F-5 August, 12.
Guns for the French mounted artillery G-1, October, 12.
Latest about heavy and siege artillery-- G-1, July-August, 12.
Machine guns of latest construction—A-2, No. 5, 12.
New Krupp mountain gun G-1, October, 12.
Powerful portable guns (armored) G-4, No. 9, 12.
Quick-firing Schneider field and siege howitzers--E-7, November, 12.
The Roumanian artillery -Sp-1, September, 12.

Artillery of the 15th and 16th Centuries—1-2, June, 12.

Sights, Etc.

The testing and properties of optical instruments—US-6a, Cir. No. 27.

AUTOMOBILES, AEROSTATION

Automobiles:

Automobile exhibit at the International Exposition at Turin in 1911—I-2, March, 12.

Hydraulic speed change for automobiles—F-1, June, 12.

Military endurance test of (automobiles) vehicles of heavy weight (1st-31st of July, 1912)—F-1, August 3, 12.

Motor cycles—E-3d, August, 12.

The program of the endurance test of military trucks for 1913—F-1, November 2, 12.

Aerostation:

Aerial tactics—I-0c, March 31, 12.

Aeroplane construction as shown at the Paris aero salon—US-13, June, 12.

Aerostation and aviation in Germany—F-11, May, 12.

Aircraft for sea service—E-8, June, 12.

American aeronautic motors—US-43L, June 1, 12.

Aviation and cavalry—F-6, May, 12.

Air-craft for use in war—E-7, August, 12.

Aerial engineering—US-0a, August, 12.

The aeroplane and the cavalry—US-24, July, 12.

The aeroplane in the military maneuvers—US-42, August 24, 12.

Aeroplane safety—F-5, June, 12.

An analysis of flight—US-0, September, 12.

Aviation—E-9, July, 12.

Dirigibles in the Italian maneuvers of 1911—F-8, July, 12.

The center-of-pressure travel on aeroplane surfaces and on bird's wings—E-5, June 28, 12.

Dirigibles at the Grand Maneuvers in Italy in 1911—I-2, February, 12.

The employment of aeroplanes at the Austrian maneuvers of 1911—I-0c, March 31, 12.

The fallacy of the dirigible—US-0, July, 12.

A gasoline engine with auto-ignition—US-43L, June 1, 12.

Instruments for safety in flight—US-0, May-June, 12.

Millerand's laws of the air—I-0c, March 31, 12.

The military aeroplane—E-5, May 17, 12.

Military aviation in America—its needs—US-16b, May-June, 12.

Motor flight and air sailing or gliding—US-43L, June 8, 12.

A new hydro-aeroplane—I-3, May, 12.

Notes on the recent experiments of M. Eiffel—US-0, July, 12.

Pilots for aeroplanes—I-0c, March 31, 12.

Progress in aeronautics—E-3d, May, 12; E-20, July, 12.

Research for the security of the aeroplane—I-0c, March 31, 12.

Steps necessary for progress in aviation—US-31, June, 12.

The Tatin-Paulhan aero-torpedo—US-43L, July 6, 12.

The theoretical basis of aviation—F-10, April, 12.

The Thomas monoplane—US-0, May-June, 12.

U. S. army war machine from the Burgess Co.—US-0, May-June, 12.

The Wright model C—US-0, May-June, 12.

Early experience with balloons in war—US-40a, September-October, 12.

Elements of theoretical aeromechanics—US-43L, July 13, 20, 27, August 3, 12.

Employment of aeroplanes in artillery service—I-2, April, 12.

Experimental research in aeronautics—US-43L, September 14, 12.

Experiments with various types of propellers—I-0c, March 31, 12.

Experiments with an Italian hydro-aeroplane—I-3, June, 12.

The flying boat and its possibilities—US-42, September 14, 12.

The fundamentals of aviation in theory—F-10, May, 12.

Grenadiers of the air—US-42, September 14, 12.

German instructions for warfare near forts—I-2, April, 12.

Has the true basic principle of flight been discovered—E-5, August 30, September 6, 12.

A hangar ship—US-0a, August, 12.

To fire from the skies—US-44d, October, 12.

The hydro-aeroplane competition at St. Malo—F-12, August 31, 12.

The Lewis automatic gun—US-16b, July-August, 12.

Military aeronautics—S-5, September 8, 12.

Military aeroplanes—E-5, August 9, 12.

The military aeroplane competitions—E-4, September 6, 12.

The military role in aerial navigation—E-3d, July, 12.

The modern aeroplane—US-41c, April, 12.

Photography and telephotography from aeroplanes and dirigibles—I-2, April, 12.

The problem of mechanical flight—US-41b, September, 13, 12.

Progress in aeronautics—E-20, August, September, 12.

Studying the flying machine in the laboratory—US-42, September 14, 12.

Strength in aeroplane construction—F-5, July, 12.

Requirements for navy hydro-aeroplanes—US-0a, September, 12.

Trajectories and cambered planes—E-7, September, 12.

The utilization of aeroplanes and dirigibles for observation of fire of coast batteries and battleships—E-7, September, 12.

The war office aeroplane competition—E-5, August 16, 30, Sept. 6, 12.

What is being done to make aviation safe in Europe—US-0a, August, 12.

Aerodynamic apparatus and experiments of 1909 —F-2, July, 12.

Aasens grenades for balloons and aeroplanes—G-1, No. 7, 12.

Artillery of the air —G-1, October, 12.

Aerial photography by kite—S-6, July-August,12.

Aerial warfare—E-7, October, 12.

Airoplanes in coast warfare—US-23a, September-October, 12.

Aeroplanes in war to-day—F-1b, November 1, 12.

On aeroplane security: relation of stability to security—F-2, September, 12.

Aeronautics—1-3, September, 12.

Aeronautics. An interesting invention —US-23a, September-October, 12.

Aeronautics in imperial German maneuvers in 1911—F-8, August, 12.

Aviation at the French maneuvers —US-12, October 19, 12.

The aviation squadron in the Connecticut maneuver campaign—US-21, November, 12.

Aviation in war. The aeroplane as a combat arm. Its influence on strategy and tactics M-6, March, 12.

Ballistics of aeroplanes—Sp-1, April, 12.

Balloons and flying machines on the Tripolitan theater of operations—S-4, June, 12.
The British military aeroplane competition—US-Oa, October, 12.
Concerning the firing of projectiles from flying machines—G-10, November 1, 12.
The control of aeroplanes—E-5, September 27, 12.
Defense of a place against an aero attack—Sp-2, July, 12; A-3, October, 12.
Dirigibles and aeroplanes in the European maneuvers—M-2b, July-August, 12.
Dirigibles and aeroplanes in maneuvers: the armored ship *Boerner*—S-5, September 29, 12.
Dirigibles and aeroplanes—US-23, November-December, 12.
The Donnet-Leveque hydro-aeroplane. Description, with scale drawings, of the most successful French flying boat—US-43L, November 2, 12.
The theoretical principles of aviation—F-10, June, 12.
Experiences of an observer concerning aviation—S-4, October, 12.
Experimental methods with aerial sails and helices—F-2, July, 12.
The evolution of German aviation—US-Oa, October, 12.
The German national contribution to aviation and German aerial navigation—G-6, May 2, 12.
Hydro-aeroplanes—1-3, July-August, 12.
Infantry fire against aeroplanes—S-2, September, 12.
An instrument, called *tourne-sol*, intended to facilitate observation of the terrain from an aeroplane—F-8, August, 12.
The Lewis aeroplane gun—US-23a, September-October, 12.
Military aeronautics—E-9, October, 12.
The military aeroplane competition—E-5, November 8, 12.
Military aviation in America—its needs—US-Oa, October, 12.
Military aviation at the Berlin aeronautic exposition of 1912—S-2, October, 12.
Recent experimental researches in atmospheric resistance and aviation made in the laboratories du Champ-de-Mars et d'Auteuil, etc.,—F-2, July, 12.
New regulation on artillery fire against air ships—S-4, October, 12.
Notes on dirigibles—1-3, July-August, 12.
Observation kites—F-5, August, 12.
Offensive and defensive weapons of flying machines—S-4, May, 12.
Organization of the aviation corps in the French navy—A-1, No. 9, 12.
Organization of the English aviation corps—A-3, October, 12.
An outline of the theory of ballooning—US-22, October, 12.
Progress in aeronautics—E-20, October, November, 12; E-3d, September, 12.
Recent organization of military aviation in England—S-1, June 22, 12.
Remarks by M. Eiffel on "experimental methods, etc"—F-2, July, 12.
A rifle pit as a means against balloon and aerial observation—S-4, April, 12.
Riley Scott sighting device for aeroplanes or dirigibles—F-5, August, 12.
Sighting apparatus for aerial craft—US-23a, September-October, 12.
Some of the latest types of aeroplanes for military purposes—A-2, November 5, 12.
Testing aeroplanes—US-23a, July-August, 12.
A theory for air resistances of flat planes—US-15, October 21, 12.
Throwing bombs from flying machines—G-1, April, 12.
U. S. Army aeroplane specifications—US-O, November, 12.

BALLISTICS

Exterior:

The pressure of a blow. The impact of projectiles on armor plate—US-43L, June 15, 22, 12.

Air density in gunnery—E-1, September 2, 12.

The ellipse of dispersion—F-5, July, 12.

The flight of projectiles—US-42, August 10, 17, 12.

Initial velocity of field guns—F-5, July, 12.

The mean point of impact—US-40, September, 12.

The application of the "Abdank-Abakanowicz" integraph for drawing the path of the projectile—G-4, No. 6, 12.

Measurements relative to air resistance for high velocities—G-1, September, 12.

The path of a projectile (trajectory). (From Scientific American, August 10 & 17, 12.)—G-5, November, 12.

Present state of the ballistic problem—G-1, October, 12.

Probability of hitting in action—A-1, No. 9, 12.

Recent researches relative to air resistance against projectiles in motion, and their utilization by theoretical interior ballistics—G-1, September, 12.

Interior:

The LeDuc ballistic formulæ—US-40, September, 12.

RANGE FINDING AND POINTING

Telescopic sight with movable graduation, for machine guns and rifles—S-2, August, 12.

A device for computing elevations for mortars—US-23a, July-August, 12.

A simple method of adjusting a range finder having a short base with stand—G-1, October, 12.

The telescopic sight for machine guns and rifles—G-4, No. 7, 12.

Position Finding:

Recent azimuth instruments—G-1, July-August, 12.

CAVALRY

Equipment:

Observations of an officer abroad—US-24, July, 12.

Proposed cavalry demolition pack—US-24, July, 12.

The task of the cavalry leaders—E-19, August 1, 12.

Mounts:

Buckets versus barrels—US-24, July, 12.

The charger—US-24, July, 12.

Morgans in the cavalry—US-24, July, 12.

Some remarks on our remount service and the cavalry depot—S-2, July, 12.

Thoroughbred and trotting blood—US-24, July, 12.

The boarding out system for supplying horses for the territorial force—E-2c, October, 12.

Kentucky stud farms—US-16d, July-September, 12.

The military horse and its supply—US-24, November, 12.

Training & trainers—F-6, October, 12.

PHOTOGRAPHY

Photography and telephotography from aeroplanes and dirigibles—I-2, April, 12.

Aerial photography by kite—S-6, July-August, 31.

DRILL REGULATIONS, MANEUVERS AND PRACTICE

Drill Regulations:

The French field artillery drill regulations—US-16d, April-June, 12.
Draft of drill regulations for foot troops (Austria-Hungary)—F-9, May 15, 12.
The new drill regulations for English field artillery—I-2, May, 12.
Remarks concerning our field artillery regulations—S-6, May-June, 12.
Sketch of unique infantry drill regulations—F-9, August 15, September 15, October 15, 12.
Company inspection—G-6, May 25, 12.
Consequences of the new cavalry drill regulations—F-6, August-September, 12.
Draft of firing regulations for machine guns (German)—F-9, September 15, 12.
Japanese manual of infantry fire—F-9, October, 12.
The new drill regulations of the Japanese field artillery—I-2, June, 12.

Maneuvers:

Dirigibles at the Grand Maneuvers in Italy in 1911—I-2, February, 12.
The employment of aeroplanes at the Austrian maneuvers of 1911—I-0c, March 31, 12.
Notes on the German maneuvers—US-16d, April-June, 12.
The aeroplane in the military maneuvers—US-42, August 24, 12.
Cavalry and maneuvers—F-6, July, 12; S-5, August 4, 12.
Connecticut manuevers—US-3, August 24, 12; US-44, September, 12.
The Imperial maneuvers of 1911. Employment of the German cavalry—F-6, July, 12.
The maneuvers in the west—F-0, September 3, 4, 5, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 12.
The maneuvers in the west: general instructions relative to subsistence and supplies; organization of automobile service—F-0, August 16, 12.
The maneuvers of the 3rd Corps of the Swiss army—F-0, September 8, 9, 12.
Naval maneuvers (execution of the 2d phase)—F-12, August 3, 12.
Observations on the maneuvers of 1911—F-5, June, 12.
Remarks relative to autumn maneuvers—F-0, September 6, 12.
After the army maneuvers—F-0, September 21, 12.
The army maneuvers—E-2, September 28, 12.
The army maneuvers in East Anglia—E-19, September 26, 12.
The army maneuvers of the west, in France—S-5, October 6, 13, 27, Nov. 3, 12.
Statement showing effect of fire from hostile or friendly artillery at battle exercises—G-6, July 30, 12.
At the imperial maneuvers of 1911. The employment of the German cavalry—F-6, August-September, 12.
Cavalry maneuvers—F-6, October, 12.
Cavalry in maneuvers—US-24, November, 12.
Coast defense exercises as held in the Artillery District of Chesapeake Bay during the war condition period, August 7-10, 1912—US-23a, September-October, 12.
Dirigibles and aeroplanes in the European maneuvers—M-2b, July-August, 12.
The English army maneuvers of 1912—G-6, October 29, 12.
The English naval maneuvers—I-3, September, 12.
The French grand maneuvers of 1912—S-4, June, 12.
French maneuvers and field exercises—G-6, April 30, 12.

The French naval maneuvers of 1912—G-5, September, 12.
French naval maneuvers of 1911—F-10, July, 12.
The imperial German maneuvers—M-2b, supplement, September 1, 12.
In re maneuvers—US-23, November-December, 12.
Made in Germany—US-2, November 7, 12.
Maneuvers of French cavalry, 1911—M-2, March, April, May, 12.
The maneuvers of the 3rd army corps in 1912—S-2, October, 12.
The aviation squadron in the Connecticut maneuver campaign—US-24, November, 12.
Posthumous memorandum of General Maillard on the grand maneuvers of the 6th Corps in 1888 and remarks upon present-day tactics—F-1b, October 15, 12.

Practice—Artillery, Coast:

Another note on artillery training—E-7, June, 12.
How may the best results of coast artillery target practice be secured—including preliminary instruction, training, preparation for, and conduct of, practice,—for guns of 8-inch to 12-inch caliber—US-23a, May-June, 12.
The training of infantry in co-operation with artillery—E-9, July, 12.
The young gun group commander—E-3d, August, 12.
A quiz in the regulations for the instruction and target practice of coast artillery troops—US-23a, July-August, 12.
Some considerations which affect the training of the R.G.A. in coast defense—US-23a, September-October, 12.

Practice—Artillery, Field:

Field service exercises for a battalion of light artillery—US-16d, April-June, July-September, 12.
Hits at fixed armament practice—E-7, May, 12.
The development of artillery training—E-20, September, 12.
A miniature artillery range—E-7, September, 12.
Some suggestions for the home training of a militia battery of field artillery—E-3d, August, 12.
The "cross country" of the artillery officers of the first and second divisions, July 14, 1912, at Biere—S-2, August, 12.
Co-operation between artillery and infantry—E-3, November 12, 12.
Distributing infantry in the marching columns of artillery—G-6, May 23, 12.
Firing methods of the Russian field artillery—US-23, November-December, 12.
The firing of the Dutch field artillery—G-1, May, 12.
A graphical means for avoiding some computation in topography and artillery—E-3d, September, 12.
The latest amendments of the drill regulations for the field artillery—G-1, October, 12.
New methods of fire and aiming—Sp-1, July, 12.
A plea for the better training of the battery signaller—E-3d, September, 12.
The reorganization of the Dutch field artillery and its new firing regulations—F-5, August, 12; S-4, April, 12.
Schools of fire of the German field artillery—F-5, August, 12.
Service firing exercises of the Austrian-Hungary fortress artillery—G-1, June, 12.
Simplifying the regular methods of firing of the field artillery—G-1, April, 12.
Some aids to training in territorial batteries—E-7, October, 12.
A study of fire effect—F-5, September, 12.

The training of the reserve officers in the field artillery regiments—G-1, October, 12.

Practice—Cavalry:

Aeroplanes and their influence upon cavalry training—E-20, August, 12.
Cavalry in maneuvers—F-6, July, 12; S-5, August 4, 12; US-24, November, 12.
Commands by signals in the cavalry—F-0, August 9, 12.
Drill and instruction of the second cavalry division—S-5, July 21, 12.
Notes on the new Russian cavalry drill regulations—US-24, Sept., 12.
Observations of an officer abroad—US-24, July, 12.
Consequences of the new cavalry drill regulations—F-6, August-September, 12.
Some cavalry needs—US-24, November, 12.
Some features in squadron training—E-3d, September, 12.

Practice—Infantry:

The company officer and his work—US-16b, July-August, 12.
Infantry training—US-16b, July-August, 12.
Garrison rifle ranges—S-5, September 15, 12.
The bayonet in favor—F-1b, November 1, 12.
The Casey fire problem—US-16b, September-October, 12.
Co-operation between artillery and infantry—E-3, November 12, 12.
Distributing infantry in the marching columns of artillery—G-6, May 23, 12.
Estimating distances—G-6, April 18, 12.
Japanese manual of infantry fire—F-9, October, 12.
A method of instructing infantry in the attack—US-16b, September-October, 12.
The model regiment's results—US-30a, October, 12.
The national shoot at Sea Girt—US-30a, October, 12.
Recruit training in the Territorial infantry—E-2c, October, 12.
Territorial musketry—E-20, October, 12.
Individual training of the marksman—F-9, May 15, June 15, July 15, August 15, 12.
Machine guns and the infantry—S-5, September 1, 12.
Practice under service conditions—S-2, June, 12.
Sketch of unique infantry drill regulations—F-9, June 15, July 15, 12.
Some notes on musketry training—E-3d, July, 12.
The training of infantry in co-operation with artillery—E-9, July, 12.

Practice—General:

Camping—E-3d, August, 12.
Lost labor and wasted time. (Notes on instruction of the "cadres")—F-1b, July 1, 15, August 1, September 1, 15, 12.
Methodical instruction of non-commissioned officers, corporals, and lance corporals—F-1b, June 15, July 1, 15, 12.
New regulations for field service—S-2, June, July, 12.
General directions for instruction in night combats—M-6, April, 12.
The training of Austrian-Hungary army —S-1, May 1, 12.
Universal training in the naval or military forces of the Australian Commonwealth—E-8, September, 12.

Practice—Naval:

Firings at the *San Marcos*—F-10, April, 12.
Fire control in France and abroad—F-12, July 20, 12.
The naval maneuvers—F-12, August 10, 17, 12.
Big gun practice in the navy—US-2, October 3, 12.

Guide for the officer in charge of the compass—F-10, July, 12.
A practical new process for rapid nautical calculations—P-1, July, 12.
The rapidity of fire of naval guns—US-23a, July-August, 12.
The training of the English naval officer—A-1, No. 7, 12.
Universal training in the naval or military forces of the Australian Commonwealth—E-8, September, 12.

ELECTRICITY

Communications:
Military telegraph lines using the polarized sounder as receiving instrument —US-43L, June, 12.
One-waveness in wireless telegraphy; pseudo-impact excitation—US-22, May, 12.
Telegraphy and telephony—E-3a, May 31, 12.
The theory of the submarine telegraph cable—E-3a, May 31, 12.
"Wired wireless" for military purposes—US-13, July, 12.
Wireless telegraphy—E-7, May, 12.
Wireless telegraphy for army purposes—E-2c, July, 12.
The communications in a coast fortress—E-7, August, 12.
Locating cable grounds—US-10, August 3, 12.
Telephoning under the ocean—US-44d, August, 12.
Telephony for long distances—A-4, July 12, 12.
Wireless telegraphy in the Italian-Turkish War—G-6, September 17, 12.
Wireless telegraphy without sparks—F-1, October 12, 12.
General:
Copper wire tables—US-6b, Cir. No. 31.
Locating cable grounds—US-10, August 3, 12.
Electrical equipment for the propulsion of the U. S. Collier *Jupiter*—US-16a, August, 12; E-3a, August 30, 12; E-5, August 23, 12.
Light:
Condensers in series with metal filament lamps—E-3a, May 24, 12.
Searchlights. Apparatus for use on shipboard—US-8, June, 12.
Standard specifications for the purchase of incandescent electric lamps— —US-6a, Cir. No. 13.
Radiant efficiency of incandescent filaments—US-22, May, 12.
The application to temporary bridges of a quick method of calculating mobile loads—I-2, July-August, 12.
Importance and application of searchlights—G-6, May 9, 12.
Power:
Electrical equipment for the propulsion of the U. S. Collier *Jupiter*—US-16a, August, 12; E-3a, August 30, 12; E-5, August 23, 12.
Coast artillery school power plant—US-23a, May-June, 12.
The cost of generating electrical power at small plants—US-44b, June, 12.
The transmission of electrical energy by direct current on the series system—E-3a, June 14, 12.
Electric propulsion of ships—E-3a, August 30, 12.
The relation of the horsepower to the kilowatt —US-41b, July 19, 12.

BOILERS

Coast artillery school power plant—US-23a, May-June, 12.
Pyrometer testing and heat measurements—US-6a, Cir. No. 7.
The standardization of bomb calorimeters—US-6a, Cir. No. 11.

Steam boiler testing—US-23a, May-June, 12.
Boilers and engines (naval)—F-12, June 22, 12.
Marine boilers with superheaters—I-3, July-August, 12.

ENGINES

Gas:

Bituminous coal producers for power —US-37, June, 12.
American aeronautic motors—US-43L, June 1, 12.
The Diesel engine from the user's standpoint—E-3a, May 31, 12; E-3b, May 31, 12.
The Diesel engine in Great Britain—US-13, June, 12.
The explosion-motor—F-8, May, 12.
Four-cylinder four-cycle Diesel engines—E-5, May 24, 12.
A gasoline engine with auto-ignition—US-43L, June 1, 12.
Heavy-oil engines—E-5, May 17, 31, 12.
Marine propulsion—E-5, May 24, 12.
The present status of the Diesel engine in Europe—US-43L, June 1, 12; US-37, June, 12.
The *Selandia*—US-43L, June 22, 12.
The two-cycle marine Diesel engine—US-42, June 1, 12.
What is the future of the oil engine in the United States—US-15, May 30, 12.
The high-power internal combustion engine two-cycle or four-cycle—F-12, August 10, 12.
The internal combustion engine—F-8, July, 12.
Replenishment of fuel oil—F-12, August 24, 12.
Comparative fuel values of gasolene and denatured alcohol in internal-combustion engines—US-7b, Bulletin 43, 12.
Double stroke heat motors—I-3, July-August, 12.
Electirc ignition of internal combustion engines, its recent advance—F-2, June, 12.
The internal combustion engine—F-8, August, September, October, 12.

Steam:

Coast artillery school power plant—US-23a, May-June, 12.
The Ljungstrom reaction steam turbine—F-1, May 18, 12.
Marine propulsion—E-5, May 24, 12.
New developments in steam turbine engineering—US-26, May, 12.
Tests of a simple engine—US-43L, July 13, 12.
The turbine and battleships—E-4, August 23, 12.
The Corliss engine. What is its distinctive feature?—US-43L, November 2, 12.

General:

The commission on oil engines for the navy—E-4, July 26, 12.
Electric propulsion of the United States collier *Jupiter*—E-5, August 23, 12; E-3a, August 30, 12; US-16a, August, 12.
Fuel for warships—E-19, July 25, 12.
High pressure turbine pumps—US-40, September, 12.
The internal combustion motor—F-8, June, 12.
Recent developments in steam turbine engineering—E-11, August 30, 12.
Arrangement and results of investigation in the turbine laboratory at the German technical highschool, Brunn—A-1, April, 26, 32.

MECHANISM, MINES, TORPEDOES, ETC.

The German naval architects. The development of the torpedo—E-4, June 21, 12.
The gyroscope compass—F-12, May 25, 12.
Submarine mine defense of coast fortresses—US-23a, May-June, 12.
The testing of hydrometers—US-6a, Cir. No. 16.
Launching of torpedoes at long ranges—I-3, June, 12.
A new form of underwater attack—US-42, August 3, 12.
The wireless directed torpedo—US-42, July 20, 12.
Automatic submarine mines—US-23a, July-August, September-October, 12.,
Davis gun torpedo—I-3, September, 12; US-23a, July-August, 12.
The Georz periscope for torpedo-batteriers and submarine mines—US-23a July-August, 12.
On the tactical use of torpedoes—M-4, August, 12.
Report of submarine mine cable testing and repairs—US-23a, July-August, 12.
Submarine mine defense of coast fortresses—US-23a, July-August, 12.
Whitehead torpedoes—M-5, August, 12.

ENGINEERING

The three-point problem and hydrographic surveys—US-40a, July-Aug., 12.
General, Civil, Etc.:
Mechanical appliances on the Panama Canal—US-8, June, 12.
The Panama Canal—description of the present stage of the work—F-1, May 25, June 1, 12.
The Panama Canal. Probable tonnage and revenue. Economic consequences—F-1, June 8, 12.
Panama—personal impressions of the work—US-42, June 8, 12.
Description and cost of concrete superstructures for breakwaters at Harbor Beach, Mich.—US-40a, September-October, 12.
Factors affecting the safe and economical operation of boats in a restricted channel in the Hudson river—US-40a, September-October, 12.
A method of proportioning concrete—US-15, August 1, 12.
Water supply of the Orleans Canal (French) by the elevation of water from pool to pool—US-40a, September-October, 12.
The development of regulation works and use of concrete in the improvement of the Missouri river—US-40a, November-December, 12.
Flood control of the Mississippi river—US-16, October 26, 12.
Flood protection for Mississippi valley—US-21, October, 12.
The gatun dam and locks—US-42, November 9, 12.
Hydraulic dredges and dredging on the improvement of the upper Mississippi river—US-40a, November-December, 12.
The Mississippi river flood of 1912—US-4a, September, 12.
Observations on the corrosion of steel in water—E-7a, Part II, 11.
Oil-mixed Portland cement concrete—US-43L, September 21, 12.
A simple method of plotting soundings in hydrographic surveys—US-15, September 26, 12.
Military:
Trenches for complete protection—I-2, March, 12.
Draft of revised manual (Japanese) of field fortifications—F-9, August 15, September 15, October 15, 12.
An engineer officer under Wellington in the Peninsula—E-14, September, 12.

A field drawbridge—E-14, August, 12.
German manual of field works for troops of all arms—F-11, June, 12.
The influence of high ground in defense—E-14, August, 12.
New bridge material of the German army—I-2, May, 12.
Some recent tendencies in field engineering—US-40a, September-October, 12.
Economy in defensive works—Sp-2, May, 12.
Field bridges—M-0, August, 12.
History of siege warfare—F-8, August, September, October, 12.
Japanese regulations for field fortification—A-2, No. 11, 12.
Nomogrammes for the calculation of hasty bridges and foot-bridges—F-8, September, 12.
A rifle-pit as a means against balloon and aerial observation—S-4, April, 12.

Fortifications:

The experience of war in Algeria (1830-1857)—I-2, March, 12.
Antwerp impregnable and untenable—S-5, September 8, 29, 12.
The control of motor driven ventilating fans—US-10, August 17, 12.
History of siege operations—F-8, July, 12.
The military archæelogy of Kent—E-14, September, 12.
Progress of the fortifications of Antwerp—S-5, August 25, 12.
The selection of an electric fan—US-9, August, 12.
The development of fortification in Germany since the introduction of rifled guns until the most recent times—G-1, July-August, 12.

LAW

International:

Approval of the Declaration of London by the United States Senate—US-0dL, July, 12.
The arbitration treaties and the senate amendments—US-0dL, July, 12.
Capture after capitulation: A juristic anachronism—US-0dL, July, 12.
Convention between the United States and other powers establishing an international law commission—US-0dL, Sup., July, 12.
The development of the Monroe Doctrine—US-0dL, July, 12.
General arbitration treaties—US-0dL, July, 12.
Naturalization convention between the United States and Nicaragua—US-0dL, Sup., July, 12.
Persons and property in time of war—E-3d, July, 12.
The real significance of the Declaration of London—US-0dL, July, 12.
The American Institute of International Law—US-0dL, October, 12.
The Christiania meeting of the Institute of International Law—US-0dL, October, 12.
The concentration of the French fleet in the Mediterranean and the Triple Entente—US-0dL, October, 12.
Contraband of war, according to the Declaration of London—F-10, June, 12.
The law of nations—US-0dL, October, 12.
Notes on rivers as boundaries—US-0dL, October, 12.
The Panama Canal Act—US-0dL, October, 12.
Some reflections upon the laws of war—S-2, September, 12.
The treaty-making power of the United States and the methods of its enforcement as affecting the police power of the states—US-35, August-September, 12.

Military:

The new military law in Germany. (Law of June 14, 1912)—F-11, July, 12.

The new military law in Holland—F-11, July, 12.

Organization of the corps of officers of military justice in Bulgaria—US-4, August 24, 12.

Persons and property in time of war—E-3d, July, 12.

Reorganization of the Dutch field artillery—F-5, June, 12.

Courts-martial—E-20, October, 12.

The recent legislative reform in the organization of the naval service—I-3, July-August, 12.

The new military laws in Germany—I-2, July-August, 12.

Some ancient articles of war—E-20, November, 12.

Municipal:

A study of French legislation concerning shipwrecks—F-10, May, 12.

Some legal aspects of the Confiscation Acts of the Civil War—US-0aL, October, 12.

METALLURGY

Manufacture and treatment of steel for guns—E-5, May 17, 12; US-43L, August 24, 31, 12.

Thermit welding in Galveston district—US-40a, July-August, 12.

The Fried. Krupp establishments, Essen—E-5, August 9, 16, 12.

Steels made in the electric furnace—US-8, August, 12.

The centenary of the Krupp works—F-1, October, 12, 12.

Development of the Krupp works—G-8, August 8, 12.

The Krupp works—S-2, September, 12.

Method of producing sound ingots—E-5, October 4, 12; E-11, October 25, 12.

MILITARY GEOGRAPHY

Egypt—E-9, July, 12.

The strategical geography of the near East—E-7, August, 12.

MILITARY HISTORY AND BIOGRAPHY

Battles, Campaigns:

Battle of Kinchou—E-7, September, 12.

Borodino, 7th of September, 1812—E-20, September, 12.

The campaign of 1805—E-20, August, 12; F-1b, June 15, July 15, August 15, 12.

The final campaign against Tippu—E-9, July, 12.

The centenary of the battle of Moscow—S-5, September 8, 12.

From Ulm to Brunn—E-20, September, 12.

The Japanese in Manchuria—F-9, August 15, 12.

Margueritte's division at Sedan (two documents)—F-6, July, 12.

The naval campaign of Pietro Mogenigo—I-3, June, 12.

The role of the Tenth Corps on August 16, 1870—F-1b, September 1, 12.

Studies in minor tactics: The abortive attack on Mosby, April 1st, 1863—E-20, September, 12.

On the trail of the swamp fox—US-23, September-October, 12.

The truth about Chickamauga—US-24, September, 12.

A visit to some battlefields in Northern Virginia—E-7, September, 12.

An account of the Battle of Laio Yang—E-3d, September, 12.

An African chasseur in the army of the east (1870-1871)—F-6, October, 12.

Austerlitz: December 2nd, 1805—E-20, October, 12.

The battle of Isly, August 14, 1844—F-9, October, 12.

The battle of New Market, Va.—US-23, November-December, 12.
The battle of the Yalu River—M-4, September, 12.
The campaign of the Boyne, 1690, and the events which preceded it—E-2c, October, 12.
The campaign of Austerlitz—E-20, October, 12.
Coast defense in the Civil War—The Port Royal Expedition—US-23a, September-October, 12.
The Comte de Guebriant at the siege of Brisach—in 1638—F-6, August-September, 12.
The Dickson Manuscripts. Review of Chapters VI and VII (1813), Series C—E-7, October, 12.
An engineer officer under Wellington in the Peninsula—E-14, September, October, November, 12.
The Germans and Swiss in Russia in 1812—S-3, August, 12.
Incidents during the Seven Days compared with the training manuals—E-20, October, 12.
Napoleon's Campaign in Poland. On the Vistula, Passarge, and Alle, 1806-1807. (With Maps)—E-7, October, November, 12.
Naval battles of 1812. The *Wasp* and *Frolic*—US-31, November, 12.
Ochterlony's campaign in the Simla Hills—E-9, October, 12.
Recollections in Portugal and Spain during 1811 and 1812—E-8, October, 12.
The role of the 10th corps on the 16th of August, 1870—F-1b, Sept. 15, 12.
Wellington and Waterloo—US-23, November-December, 12

Biography:

Hannibal—E-3d, May, 12.
Bashforth, 1819-1912—E-1, August 1, 12.
Bernard—US-23, September-October, 12.
William Barker Cushing—US-40, September, 12.
Major General Sir Isaac Brock, one of the chief heroes of Upper Canada, 1802-13—E-3, August 27, 12.
Brief military and political history of Alfonso XI—Sp-2, April, 12.
Characteristics of Napoleon I. as a man—S-3, August, 12.
The Comte de Guebriant at the siege of Brisach—F-6, August-September, 12.
The Dickson Manuscripts. Review of Chapters VI and VII -(1813), Series C—E-7, October, 12.
Letters to George III. from Lieut.-General Viscount Townshend—E-8, October, 12.

General Military:

An account of the battle of Liao Yang—E-2c, July, 12.
The Confederate armies—US-8c, June, 12.
Grant's attack on Petersburg, 1864—E-3d, June, 12.
Lessons of the Wilderness campaign, 1864—E-3d, May, 12.
A lady's experiences in the great siege of Gibraltar (1779-83)—E-14, June, July, 12.
The *Monitor* and the *Merrimac*—US-20, May, 12.
Recollections of the Crimea—F-6, May, 12.
The revolution in China—E-8, May, 12.
Russo-Japanese war. The employment of field artillery from June to October, 1904—E-7, July, 12.
The siege of Petersburg, 1864-65—E-2c, July, 12.
Statistics of Confederate generals—US-8c, June, 12.

The battle of New Market, Va.—US-23, November-December, 12.
The battle of the Yalu River—M-4, September, 12.
The campaign of the Boyne, 1690, and the events which preceded it—E-2c, October, 12.
The campaign of Austerlitz—E-20, October, 12.
Coast defense in the Civil War—The Port Royal Expedition—US-23a, September-October, 12.
The Comte de Guebriant at the siege of Brisach—in 1638—F-6, August-September, 12.
The Dickson Manuscripts. Review of Chapters VI and VII (1813), Series C—E-7, October, 12.
An engineer officer under Wellington in the Peninsula—E-14, September, October, November, 12.
The Germans and Swiss in Russia in 1812—S-3, August, 12.
Incidents during the Seven Days compared with the training manuals—E-20, October, 12.
Napoleon's Campaign in Poland. On the Vistula, Passarge, and Alle, 1806-1807. (With Maps)—E-7, October, November, 12.
Naval battles of 1812. The *Wasp* and *Frolic*—US-31, November, 12.
Ochterlony's campaign in the Simla Hills—E-9, October, 12.
Recollections in Portugal and Spain during 1811 and 1812—E-8, October, 12.
The role of the 10th corps on the 16th of August, 1870—F-1b, Sept. 15, 12.
Wellington and Waterloo—US-23, November-December, 12

Biography:

Hannibal—E-3d, May, 12.
Bashforth, 1819-1912—E-1, August 1, 12.
Bernard—US-23, September-October, 12.
William Barker Cushing—US-40, September, 12.
Major General Sir Isaac Brock, one of the chief heroes of Upper Canada, 1802-13—E-3, August 27, 12.
Brief military and political history of Alfonso XI—Sp-2, April, 12.
Characteristics of Napoleon I. as a man—S-3, August, 12.
The Comte de Guebriant at the siege of Brisach—F-6, August-September, 12.
The Dickson Manuscripts. Review of Chapters VI and VII -(1813), Series C—E-7, October, 12.
Letters to George III. from Lieut.-General Viscount Townshend—E-8, October, 12.

General Military:

An account of the battle of Liao Yang—E-2c, July, 12.
The Confederate armies—US-8c, June, 12.
Grant's attack on Petersburg, 1864—E-3d, June, 12.
Lessons of the Wilderness campaign, 1864—E-3d, May, 12.
A lady's experiences in the great siege of Gibraltar (1779-83)—E-14, June, July, 12.
The *Monitor* and the *Merrimac*—US-20, May, 12.
Recollections of the Crimea—F-6, May, 12.
The revolution in China—E-8, May, 12.
Russo-Japanese war. The employment of field artillery from June to October, 1904—E-7, July, 12.
The siege of Petersburg, 1864-65—E-2c, July, 12.
Statistics of Confederate generals—US-8c, June, 12.

The battle of New Market, Va.—US-23, November-December, 12.
The battle of the Yalu River—M-4, September, 12.
The campaign of the Boyne, 1690, and the events which preceded it—E-2c, October, 12.
The campaign of Austerlitz—E-20, October, 12.
Coast defense in the Civil War—The Port Royal Expedition—US-23a, September-October, 12.
The Comte de Guebriant at the siege of Brisach—in 1638—F-6, August-September, 12.
The Dickson Manuscripts. Review of Chapters VI and VII (1813), Series C—E-7, October, 12.
An engineer officer under Wellington in the Peninsula—E-14, September, October, November, 12.
The Germans and Swiss in Russia in 1812—S-3, August, 12.
Incidents during the Seven Days compared with the training manuals—E-20, October, 12.
Napoleon's Campaign in Poland. On the Vistula, Passarge, and Alle, 1806-1807. (With Maps)—E-7, October, November, 12.
Naval battles of 1812. The *Wasp* and *Frolic*—US-31, November, 12.
Ochterlony's campaign in the Simla Hills—E-9, October, 12.
Recollections in Portugal and Spain during 1811 and 1812—E-8, October, 12.
The role of the 10th corps on the 16th of August, 1870—F-1b, Sept. 15, 12.
Wellington and Waterloo—US-23, November-December, 12

Biography:

Hannibal—E-3d, May, 12.
Bashforth, 1819-1912—E-1, August 1, 12.
Bernard—US-23, September-October, 12.
William Barker Cushing—US-40, September, 12.
Major General Sir Isaac Brock, one of the chief heroes of Upper Canada, 1802-13—E-3, August 27, 12.
Brief military and political history of Alfonso XI—Sp-2, April, 12.
Characteristics of Napoleon I. as a man—S-3, August, 12.
The Comte de Guebriant at the siege of Brisach—F-6, August-September, 12.
The Dickson Manuscripts. Review of Chapters VI and VII -(1813), Series C—E-7, October, 12.
Letters to George III. from Lieut.-General Viscount Townshend—E-8, October, 12.

General Military:

An account of the battle of Liao Yang—E-2c, July, 12.
The Confederate armies—US-8c, June, 12.
Grant's attack on Petersburg, 1864—E-3d, June, 12.
Lessons of the Wilderness campaign, 1864—E-3d, May, 12.
A lady's experiences in the great siege of Gibraltar (1779-83)—E-14, June, July, 12.
The *Monitor* and the *Merrimac*—US-20, May, 12.
Recollections of the Crimea—F-6, May, 12.
The revolution in China—E-8, May, 12.
Russo-Japanese war. The employment of field artillery from June to October, 1904—E-7, July, 12.
The siege of Petersburg, 1864-65—E-2c, July, 12.
Statistics of Confederate generals—US-8c, June, 12.

Switzerland in 1815. The second passage of the allies and the Franche-Comte expedition—S-2, May, June, 12.

The war in the Mediterranean; (a) Naval; (b) Military measures; (c) Military operations; (d) Aeronautics; (e) Neutrals—E-8, May, June, 12.

A contribution to the history of the artillery. The right to command—F-5, June, July, 12.

Egypt—E-9, July, 12.

An engineer officer under Wellington in the Peninsula—E-14, August, 12.

An episode of the Russo-Japanese war. (The attack of Tchjantan-Khenan by the Russians)—F-9, May 15, 12.

The field of Argaum, 29th November, 1803—E-20, August, 12.

Historical documents of Major-General Sir J. T. Jones—E-14, August, 12.

Journal of captivity (1870)—F-6, July, 12.

The Medical Department of the United States Army in the Civil War—US-29, August, 12.

The memoirs of the Prussian army—S-2, July, 12.

The military archæology of Kent—E-14, September, 12.

The observatory at Waterloo—US-23, September-October, 12.

An old French memoir on India, 1801—E-9, July, 12.

My recollection of an Indian battlefield—E-14, August, 12.

The role of the 10th Corps on the 16th of August, 1870—F-1b, August 1, 15, 12.

Sketch of First Missouri Battery, C. S. A.—US-8c, September, 12.

Some Royal Engineer orders at the siege of Gibraltar—E-14, August, 12.

An unpublished fragment of Jomini's memoirs—S-2, August, 12.

Causes of the failure of Austria in the wars of 1859 and 1866—S-5, Oct. 27, 12.

Coast defense in the Civil War. Hatteras Inlet, N. C.—US-23a, July-August, 12.

The date of the introduction of the tangent scale in the Royal Artillery—E-7, November, 12.

The development of the art of defense—S-1, June 8, 12.

Doctrine, conception and history of war—US-16b, September-October, 12.

The development of our (Austrian) army during the time of Archduke Charles—A-3, May, 12.

The evolution of war—F-1b, September 15, 12.

Hanseatic troops of the past and present—G-9, November, 12.

History of siege operations—F-8, August, September, 12.

The last of the Invalides—E-20, November, 12.

The Medical Department of the United States in the Civil War. The great battle of the west, Chickamauga—US-29, October, 12.

The military policy and institutions of the British empire—E-20, October, 12.

The Prussian army in the year 1812—G-5, November, 12.

The reasons for the Russian-Japanese war according to the Japanese version—G-5, August, 12.

What can be done for our military history—US-16b, Sept.-Oct., 12.

The work of the General Staff in the Seven Years War—G-6, May 14, 12.

Genal Naval:

Some forgotten admirals of the sixteenth century; or, Turkey in North Africa during the sixteenth century—E-20, July, 12.

The action between the *Constitution* and the *Guerriere*—US-31, September, 12; US-4, September 7, 12.

An archbishop-admiral, Henri d'Escoubleau de Sourdis—F-10, May, 12.

The navy and the Peninsular war—E-20, July, September, 12.
The naval campaign of Pietro Mogenigo—I-3, June, 12.
The Naval Ministry under the old regime—F-10, May, 12.
St. Vincent—February, 1797—E-20, August, 12.
The Hanse in the history of naval warfare—G-9, November, 12.
The jubilee of the turret ship—US-23a, July-August, 12.
Marine operations. Russo-Japanese war—M-5, March, April, May, June, July, August, 12.
Official history of the Russo-Japanese naval war—Sp-3, April, May, June, July, 12.
The Sabaudo-Piemontese fleet from 1431 to 1859—I-3, July-August, 12.
The struggle for sea power. The navy of France in the past and to-day—E-20, October, November, 12.
The trasmission of orders in the naval actions of the Russian-Japanese War—G-5, August, 12.

Recent:

The Italian-Turkish War—US-40, September, 12; F-10, May, 12.
The Japanese in Manchuria—F-9, July 15, 12.
In Morocco—F-6, July, August, September, 12.
Minor operations along the boundary between Morocco and Algeria—F-0, July 23, 12.
Naval operations in the Italo-Turkish war during the first half of 1912—F-12, July 27, 12.
Our (Italy's) war in Africa—S-2, July, 12.
The Russo-Japanese war and the future of Russia—E-20, August, 12.
Some lessons of the Russo-Japanese War applied to 1912—E-20, Sept., 12.
The struggle for sea power. The navy of France in the past and to-day—E-20, September, 12.
The war in the Mediterranean—E-8, August, September, 12; E-3d, August, September, 12.
The Balkan War—US-31, November, 12; G-5, November, 12.
Balkan war notes—US-23, November-December, 12.
Balloons and flying machines on the Tripolitan theater of operations—S-4, June, 12.
Geographical-strategical considerations concerning the disposition of the different Balkan armires—G-5, November, 12.
Grouping the Austrian-Hungary army along the Italian frontier—S-3, July, 12.
The Italian squadron in the Dardenelles—M-5, June, 12.
The Italian Turkish war—P-4, June, 12; G-5, November, 12.
Present military situation in the Balkan states—F-11, October, 12.
The war carried on in the Aegean Sea—S-3, June, 12.
Wireless telegraphy in the Italian-Turkish war—G-6, September 17, 12.

MILITARY SCHOOLS

Notes on the course at the school of fire—US-16d, April-June, July-September, 12.
A Siamese West Point—US-16d, May-June, 12.
Daily diary of equitation work at the Mounted Service School—US-24, July, Sept., 12; US-16d, July-September, 12.

The military education of the youth of the country for a period of at least one year as a means of developing the military spirit of the country for the national defense—US-23, September-October, 12.
Military instruction—E-3d, August, 12.
Riding school at Stromsholm—US-24, July, 12.
Supervision and inspection of military schools—F-0, August 6, 12.
Compulsory military training in Australia—E-2c, October, 12.
Observations on the work at Saumur—US-24, November, 12.
The reform in the Italian naval academy—A-1, No. 6, 12.
The Staff College, Camberley—E-2c, October, 12.
The Staff College, Quetta—E-2c, October, 12.
The training of the English naval officer—A-1, No. 7, 12.
A visit to Toledo and its Military Academy—E-20, November, 12.

ORGANIZATION AND ADMINISTRATION

Coast Defense:
The defense of the German coasts—E-8, June, 12.
A manual for post and district ordnance officers—US-23a, May-June, 12.
Submarine mine defense of coast fortresses—US-23a, May-June, 12.
The training of a cyclist battalion for coast defense—E-2c, October, 12.
Field Artillery:
A contribution to the history of the artillery. The right to command—F-5, June, 12.
The French field artillery—E-3d, August, 12.
German field artillery—S-5, August 4, 11, 12.
A question of artillery organization—S-5, July 21, August 4, 12.
Reorganization of German field artillery—F-1b, August 15, 12.
Reorganization of the Dutch field artillery—F-5, June, August, 12.
Territorial artillery and its condition—E-19, August 8, 12.
The development of the German foot-artillery—S-1, May, 12.
Foot artillery of the German army—S-1, May 18, 12.
The possibilities of half-batteries—E-7, October, 12.
The Russian field artillery—G-1, May, 12.
Army:
Battalion organization—E-3d, July, 12.
The company officer and his work—US-16b, July-August, 12.
Battalion organization. II. The 4-company battalion in the German and French armies—E-20, October, 12.
Proportion of the three arms—US-16b, May-June, 12.
Army—England:
The Australian light horseman—E-3d, June, 12.
The best national system for providing the necessary military force; (1) To secure the safety of the United Kingdom on land; (2) To support the defense of the Empire; (3) To assist in maintaining the balance of power in Europe—E-8, May, August, 12.
The English army in 1912—F-11, August, 12.
How to employ our unattached officers: A suggestion—E-3d, July, 12.
The organization and training of the territorial artillery—E-7, August, 12.
Preparation of the English expeditionary troops—F-0, September 6, 12.
Territorial artillery and its condition—E-19, August 8, 12.
A clash of opinions. A reply to the article "Our Requirements for Home Defense," in the Army Review of July, 1912—E-2c, October, 12.

Compulsory military training in Australia—E-2c, October, 12.
The double-company system in the Indian army—E-2c, October, 12.
Army finance and management—E-2c, October, 12.
The English army at the beginning of 1912—A-3, June, 12.
Our army system in theory and practice—E-2c, October, 12.
The training of the English naval officer—A-1, No. 7, 12.

Army—Germany:

German field artillery—S-5, August 4, 11, 12.
Cursory remarks on our field artillery—G-1, July-August, 12.
The field pioneer service of all arms in the German army—S-3, October, 12.
The German field service regulations in the light of history—M-2b, April, May, June, July, August, September, 1912.
The German league for defense and compulsory military service—F-11, October, 12.
Machine gun companies in Germany—F-11, October, 12.
The question of small garrisons in Germany—S-1, May 11, 12.
Some notes on German cavalry—US-24, November, 12.

Army—Austria:

The new Austrian army bill—E-8, September, 12.
Our cyclist companies (Austria)—A-3, October, 12.
The recent field regulations for the Austrian army—S-1, August 24, 12.
Reorganization of the technical troops of the Austrian-Hungary army—S-1, September 7, 12.
The training of Austria-Hungary's army—S-1, May 4, 12.

Army—France:

A glimpse of the French army—US-23, July-August, 12.
Historical study of discipline and the right to punish in the French army—F-1b, May 15, 12.
Two or three years service—F-0, June 9, July 24, 12.
Administrative reform—F-9, May 15, 12.
A contribution to the history of the artillery—F-5, July, 12.
The French field artillery—E-3d, August, 12.
The new military law in Germany (law of June 14, 1912)—F-11, July, 12.
The inauguration of the hours (time) 0 to 21 in the French army—G-6, November 5, 12.
Let us have a chief (of French cavalry)—US-21, November, 12.
Naval ordnance designers and the artillery commission—F-5, Sept., 12.
On the eve of the organization act. The annual general report—F-6, October, 12.
Poorly instructed and poorly paid officers —F-1b, November 1, 12.
Progress of the French field artillery—G-1, September, 12.
Recent organization of the French cavalry—S-1, July 20, 12.
Remarks on the defense of the northern frontier—F-1b, November 1, 12.

Army —Italy:

Law relative to the states of officers of the Italian army—F-11, September, 12.

Army —Russia:

New service regulations of the Russian cavalry—G-6, September 5, 12.
Recent field regulations of Russia -S-1, July 20, 12.
Reorganization of the Russian army after the war against Japan -S-3, May, 12.
The Russian army (erecting a third artillery war college at Odessa)—G-6, November 5, 12.

The Russian field artillery—G-1, May, 12.

Army—Japan:

An official visit to the Japanese army—US-23, September-October, 12.

A visit to the thirteenth division, Japanese army—US-24, November, 12.

Army—Minor States:

Situation of the Brazilian army in 1912—F-11, May, 12.

The new military law in Holland—F-11, July, 12.

The Balkan question. The Turkish army—E-2, August 10, September 7, 14, 12.

The Chilian army—US-24, July, 12.

The defense of the South African Union—F-11, June, 12.

The new organization of the Swiss army—US-24, September, 12.

Organization of the corps of officers of military justice in Bulgaria—US-4, August 24, 12.

Reorganization of the army—S-5, August 25, 12.

An armed nation, indeed—F-9, September 15, 12.

The Greek army—Sp-0b, January, February, March, April, May, 12.

The Mexican army—M-3, May, 12.

New organization of the Greek army—Sp-0b, September-October, 12.

Object of the organization of the Swiss scouts—S-2, October, 12.

Organization of the Bulgarian army—Sp-0b, July, August, 12.

The organization of machine gun units in Belgium—S-5, November 3, 10, 12.

Reorganization of the Norwegian General Staff—G-6, September 14, 12.

The Roumanian artillery—Sp-1, September, 12.

The Swiss army and the Belgian army—S-5, September 15, 12.

The Swiss field regulations of 1912—S-1, August 31, 12.

The army of Brazil—Sp-0b, May, June, 12.

The army of Siam—Sp-0b, April, 12.

Army—United States:

Army reorganization—US-4, July 13, 12.

The U. S. Army in 1912—F-11, May, 12.

Army reorganization—US-4, July 20, 12.

Events of the military year 1911, in armies of foreign powers—E-8, Aug., 12.

The United States army in 1912—F-11, June, 12.

Notes on army regulations—US-23, September-October, 12.

The organization of the land forces of the United States—US-16b, July-August, 12.

The United States artillery—E-3, September 10, 12.

The army of the United States—S-1, October, 12.

The coast artillery of the United States—A-2, No. 9, 12.

Coast defenses in the United States. (Taken from Scientific American, No. 20, 1912) -G-5, November, 12.

General Military:

Battalion organization—E-20, September, 12.

A cavalry reserve—US-21, September, 12.

The relation of promotion to organization—US-21, September, 12.

Machine guns and the infantry—S-5, September 1, 12.

On the organization of the colonial army -F-1b, June 15, 12.

The organization of a division in time of peace -US-1, September 7, 12.

Service of two or three years—F-0, July 20, August 28, 12.

Some possible economies in army administration—US-16b, July-August, 12.

Cavalry and the two year law—F-0, September 21, 12.

The Chief of Staff—US-16b, September-October, 12.
The recent English regulations for service in the field—S-3, April, 12.
Relative to divisional cavalry—S-6, July-August, 12.
A study of discipline—F-1b, June 1, 12.

Technical Troops:

Reforms in the engineer service—S-5, August 4, 12.
The reorganization of machine gun units in Belgium—S-5, October 27, 12.
The role of the engineer battalion with an infantry division—US-40a, November-December, 12.

Transport and Supply:

Motor transport for army purposes—E-7, July, 12.
The progress of mechanical transport in the army—E-10a, Jan.-March, 12.
A scientific test of the electric truck—US-42, June 22, 12.
The new transport system: Its principles and their application—E-3d, August, 12.
The progress of mechanical transport in the army—E-3d, August, 12.
The service of supply subsistence—US-2, August 8, 12.
The supply of ammunition and motor transport—E-8, August, 12.
The auto-car in the supply service of the English army—I-2, July-August, 12.
Concentration of troops by rail—E-14, October, 12.
Military railways—M-6, May, 12.
Military transportation in relation to the exigencies of modern armies and mechanical progress—I-2, June, 12.
The mule in the military service—S-4, June, 12.
Railway construction in Turkey—A-3, October, 12.
Supplying ammunition to the infantry—S-1, July 13, 12.

Medical:

The Medical Department of the United States Army in the Civil War. The battle of Bull Run—US-29, June, 12.
Military absenteeism in war, with special reference to the relation of the Medical Department thereto—US-29, June, July, 12.
Antwerp impregnable and untenable—S-5, September 8, 12.
The care and sanitation of large bodies of troops in camp and field—US-23, September-October, 12.
The Medical Department of the Organized Militia depends upon the intelligent and enthusiastic co-operation of headquarters and the line for satisfactory sanitary conditions in camp—US-29, August, 12.
The Medical Department of the United States Army in the Civil War—US-29, August, 12.
Regimental stretcher bearers—E-3d, August, 12.
A scheme for carrying out venereal prophylaxis in army posts—US-29, August, 12.
The use of graphics for administrative medical services on staff tours and in the field—E-9, July, 12.
Care of the wounded in the Balkan war—G-6, November 7, 12.
A division field laboratory—Its possibilities as illustrated by experiences with the maneuver division—US-29, October, 12.
The Medical Department of the United States in the Civil War. The great battle of the west, Chickamauga—US-29, October, 12.
The military functions of an army medical service—E-2c, October, 12.
Military hygiene and sanitation; enteric fever in India—E-20, November, 12.

A motor hospital. The latest French military vehicle. US-42, September 21, 12.

A study of the diagnosis tag—US-29, October, 12.

Naval:

Organization of the aviation corps in the French navy—A-1, No. 9, 12.

The personnel reform in the French navy—G-5, July, 12.

Reorganization of the French squadrons—A-1, No. 6, 12.

Employment of naval artillery—I-3, May, 12.

Be ready for war—US-40, September, 12.

Discipline in the Navy—US-40, September, 12.

How to make a naval appropriation—US-40, September, 12.

Navy yard problems—US-40, September, 12.

Preparation in peace and success in war—US-40, September, 12.

The relations of the War College to the Navy Department—US-40, September, 12.

The change of merchantmen into men-of-war on the high seas in time of war—F-10, May, 12.

The English naval budget and Mr. Churchill's speech—F-10, May, 12.

The new German Fleet Law—and General Von Bernhardi—E-20, Sept., 12.

A scheme for a new organization of the gunner personnel—F-10, May, 12.

Scientific management—US-4, September 14, 12.

32,000 ton floating dock for the British Admiralty—E-11, September 13, 12.

The English parliamentary report relative to the standing of the principal naval powers—A-1, No. 9, 12.

The new order at the Admiralty—E-5, October 4, 12.

The ministry of the navy under the old regime—F-10, July, 12.

RECONNAISSANCE AND SKETCHING

A graphical means for avoiding some computations in topography and artillery—E-3d, September, 12.

Cavalry reconnaissance and transmission of information by modern methods—US-24, July, 12.

The service of reconnaissance with special regard to divisional cavalry—US-24, September, 12.

Light horse duties in the field: Scouting—E-3d, August, 12.

Sketching for non-commissioned officers—US-24, July, 12.

Machine guns in the service of scrutiny and information—US-24, Nov., 12.

A rifle-pit as a means against balloon and aerial observation—S-4, April, 12.

SIGNALLING

Horizontal antennæ for wireless telegraphy—I-2, May, 12.

Semaphore signaling for scouts—US-16b, July-August, 12.

Signal codes used by our revolutionary commanders for the convoy of merchantmen—US-40, September, 12.

The origin of our signal book—US-40, September, 12.

Telephoning under the ocean—US-44d, August, 12.

Tests of wireless telegraphy employing two Marconi stations—S-6, May-June, 12.

The army and the signal service—E-3d, September, 12.

Principles of wireless telegraphy—E-9d, September, 12.

A study of the telegraph and telephone in general and their applications in the field—M-1b, April, May, June, July, August, 12.
A triple mirror for secret signalling—US-42, October 26, 12.
Telephony for long distances—A-4, July 12, 12.
Wireless telegraphy without sparks—F-1, October 12, 12.

SMALL ARMS, EQUIPMENTS

Small Arms:
Automatic rifles—E-3d, June, 12.
The future military small bore rifle—E-1, June 1, 12.
Lectures to young gun makers. The Anson and Deeley safety bolt—E-1, June 1, 12.
To fire from the skies—US-44d, October, 12.
The newest thing in rifles—US-2, August 15, 12.
Telescopic sight with removable graduation, for machine guns and rifles—S-2, August, 12.
Winning the 1912 Palma—US-2, September 19, 12.
Automatic rifles—E-9, October, 12.
The Benet-Mercie automatic rifle—S-2, September, 12.
Garrison rifle ranges—S-5, September 15, 12.
Light machine guns and musket machine guns—F-5, September, 12.
Some investigations on explosive effect of modern infantry projectiles—G-10, August 15, 12.
A third party rifle—US-2, September 19, 12.
Equipments:
Scientific foot treatment for the army—US-43L, August 17, 12.
Machine guns of latest construction—A-2, No. 5, 12.
Technical equipment of Infantry—A-2, No. 5, 12.

STRATEGY AND TACTICS

Strategy:
The Napoleonic form of strategy—E-20, July, 12.
The strategical action of cavalry—E-8, June, 12.
Strategy and politics—E-10a, January-March, 12.
The Achilles Heel of the Empire—E-9, July, 12.
New regulations for field service—S-2, August, 12.
Tactics—Artillery, Coast:
Artillery in battle. (Colonel Paloque)—I-2, February, 12.
The attack of a fortress —E-7, July, 12.
Coast defense—E-7, May, 12.
Diagram of fields of fire of recent French ships—I-3, May, 12.
Reflections on artillery combat—I-2, February, 12.
The attack of a coast fortress—US-23a, September-October, 12.
Battle tactics and battle orders—US-23a, July-August, 12.
Fire control and identification of ships—E-7, October, 12.
The land-side defense of defended ports—US-23a, July-August, 12.
The present-day tactics of coast artillery—US-23a, September-October, 12.
Tactics—Artillery, Field:
Artillery on the field of battle—E-7, July, 12.
Employment of field artillery in night operations—I-2, March, 12.
Fire for effect—US-16d, April-June, 12.

Russo-Japanese war. The employment of field artillery from June to October, 1904—E-7, July, 12.
The tactics of the Japanese artillery—E-7, July, 12.
The use of field artillery—US-23a, May-June, 12.
More ideas on the artillery. (On density of fire)—F-1b, August 1, 12.
Artillery in defense of their pieces—I-2, April, 12.
A comparison of British, French, and German methods of the employment of artillery in the field (including application of fire generally), together with deductions as to the system best suited to our own army in a European campaign—E-7, June, July, August, 12.
The five years inspection of General Percin—I-2, May, 12.
Flank observation from a low-site battery—E-7, August, 12.
Methods of fire of the infantry battery—US-23, September-October, 12.
Remarks concerning our field artillery regulations—S-6, May-June, 12.
A study of fire—F-5, June, 12.
The application of artillery in field and mountain warfare—S-4, April, 12.
Artillery tactics. The "open" and "covered" positions discussed as they affect the other arms, and the necessity for fuller criticism of artillery tactics in the field—E-2c, October, 12.
Assigning artillery positions—G-6, April 20, 12.
Battle regulations of the Russian field artillery—G-4, No. 9, 12.
Coordination of field artillery with the other arms in battle—US-16b, September-October, 12.
A comparison of British, French, and German methods of the employment of artillery ("Duncan" Gold Medal Essay, 1912)—E-3d, September, 12.
The evolution of field artillery tactics—Sp-1, April, 12.
The French view relative to the co-operation of infantry and artillery. How much will its acceptance in conducting our actions be recommended—G-1, July-August, 12.
How are the disadvantages of an artillery defense overcome?—G-1, June, 12.
Recent French view relative to the application of troops in action, especially artillery—G-6, August 17, 12.
The tactical application of heavy artillery—S-4, June, 12.
The tactical employment of howitzer batteries (from the Russian field artillery)—G-1, October, 12.
Two phases in artillery co-operation—E-2c, October, 12.
The value of echelon formation as applied to artillery—G-6, July 23, 12.
Tactics—Cavalry:
Aviation and cavalry—F-6, May, 12.
The employment of cavalry—E-2c, July, 12.
The functions of cavalry—E-3d, June, 12.
Cavalry in war—US-24, September, 12.
Cavalry raids, their value and how made—US-24, September, 12.
The importance of cavalry—US-24, September, 12.
The cavalry screen—US-24, July, 12.
Commands by signal in the cavalry—F-0, August 9, 12.
Cavalry maneuvers—S-5, August 4, 12.
Long distance rides of twenty-seven patrols, French Army—US-24, Sept., 12.
The service of reconnaissance with special regard to divisional cavalry—US-24, September, 12.
The imperial maneuvers of 1911. Employment of the German cavalry—F-6, July, August, September, 12.

Machine guns with the advance guard—US-24, July, 12.

On the importance of auxiliary troops in advanced reconnaissance—S-6, May-June, 12.

The task of cavalry leaders—E-19, August 1, 12.

To the memory of divisional cavalry—S-6, May-June, 12.

Essay on the employment of cavalry—F-6, August, September, 12.

The strategical action of cavalry—E-3d, September, 12; US-24, July, 12.

The strategical employment of cavalry—US-24, November, 12; E-8, August, 12.

Tactics—Infantry:

Infantry combat—US-16b, May-June, 12.

Infantry in battle—E-3d, June, 12.

Infantry machine gun tactics—US-23, July-August, 12.

The latest development in musketry—E-3d, May, 12.

Frontage, extension, and depth of formations in attack and defense—E-3d, July, 12.

The tactical employment of the infantry machine gun—US-23, September-October, 12.

Visual signaling in Greece—F-8, June, 12.

A word on the offensive and long range fire—S-6, May-June, 12.

The French view relative to the co-operation of infantry and artillery. How much will its acceptance in conducting our actions be recommended—G-1, July-August, 12.

Infantry fire against aeroplanes—S-2, September, 12.

Infantry fire at night—G-6, July 25, 12.

Tactics—General:

Aerial tactics—I-0c, March 31, 12.

The co-operation of field artillery with infantry in the attack—E-3d, June, 12.

Conduct of operations by an advance guard in Algeria—I-2, February, 12.

Field orders and their preparation—US-2, June 6, 20, 12.

New German instructions on the fire of the mitrailleuse—I-2, February, 12.

Siege warfare—I-2, February, 12.

Submarine mine defense of coast fortresses—US-23a, May-June, 12.

Tactical co-operation between artillery and the other arms—E-7, May, 12.

The tactical employment of field defenses—E-3d, May, 12.

Frontage, extension, and depth of formations in attack and defense—E-3d, July, 12.

How to solve a tactical problem—S-2, August, 12.

The influence of high ground in defense—E-14, August, 12.

The Italian army's combat rules—F-11, August, 12.

Machine guns with the advance guard—US-24, July, 12.

Mountain warfare—F-9, May 15, June 15, 12.

Night fighting in future campaigns—E-20, August, 12.

On the importance of auxiliary troops in advanced reconnaissance—S-6, May-June, 12.

The place of doctrine in war—US-16b, July-August, 12.

The science of organization and the art of war—E-20, September, 12.

Studies in minor tactics: The combat at the Mo-tien-ling Pass, July 19th, 1904—E-20, August, September, 12.

Tactical problems—F-1b, September 1, 12.

Attack against mountain fortifications—G-1, April, 12.

Aviation in war, the aeroplane as a combat arm. Its influence on strategy and tactics—M-6, March, 12.

The combat rules of the Italian army—F-11, September, 12.

Defense of a place against an aero attack—Sp-2, July, 12.

The defense of the strait of Dover and of the English channel—F-12, October 19, 12.

Firing over one's own troops with machine-gun fire—G-6, June 29, 12.

The French view relative to the co-operation of infantry and artillery. How much will its acceptance in conducting our actions be recommended?—G-1, July-August, 12.

Higher tactics in Manchuria—E-3d, September, 12.

Hints on the solution of tactical problems—E-3d, September, 12.

The interdependence of strategy and policy—E-9, October, 12.

Individuality the fundamental principle of the Boer tactics—G-6, Beiheft, No. 8, 9, 12.

The knowledge of foreign armies and their methods of fighting—G-6, June 8, 12.

Mountain warfare—S-4, October, 12.

Our failings in "outpost duties"—E-2c, October, 12.

Posthumous memorandum of General Maillard on the grand maneuvers of the 6th Corps in 1888 and remarks upon present-day tactics—F-1b, October 15, 12.

Recent French conception of tactical questions—S-3, October, 12.

Recent French views relative to the application of troops in action, especially artillery—G-6, August 17, 12.

Relation of infantry in artillery and machine-gun fire—G-6, June 15, 12.

Remarks upon the defense of the northern frontier—F-1b, October 15, 12.

Sorties in fortress warfare—G-6, April 27, 12.

Some ideas on the attack of fortified places—F-1b, September 15, 12.

Studies in minor tactics—US-24, November, 12.

Talks about cavalry with officers of infantry and artillery—F-9, October, 12.

A tactical problem for practical solution—E-2c, October, 12.

Tactics of the three arms—M-3, July, 12.

Tactical situations and field orders—US-16b, September-October, 12.

The three arms in battle—US-16b, September-October, 12.

Tactics—Naval:

The navy's interest in the Cape Cod canal—US-20, May, 12.

Defense of home naval bases—E-3, August 27, 12.

Control of the sea: Its relation to the Russo-Japanese War—US-40, September, 12.

Notes on the applicatory system of solving war problems, with example showing the adaptation of the system to naval problems—US-40, Sept., 12.

The eternal duel of the sea—E-20, August, 12.

Note on the handling of ships in divisions—E-8, August, October, 12.

The struggle for sea power. The navy of France in the past and to-day—E-20, August, 12.

The development of sailing ship tactics compared to that of steam tactics, with a glance into the future E-8, September, October, 12.

The influence of coast fortresses on naval strategy E-8, October, 12.

Naval strategy in its relation to land strategy from the English-American viewpoint—G-5, July, 12.

Opportune considerations on naval tactics—A-1, No. 11, 12.
The ocean as a battlefield—G-9, No. 8, 12.
The transmission of orders in the naval actions of the Russian-Japanese war G-5, August, 12.

SUBMARINES AND TORPEDOBOATS

Submarines:

The Italian submersible *Atropo*—E-4, July 12, 12.
After the *Vendemiaire* catastrophe—F-12, July 13, 12.
The *Kanguroo* embarking the Peruvian submersible *Ferre*—F-12, July 13, 12; F-1, July 27, 12.
Submarines in the maneuvers in the north—F-12, August 31, 12.
Submarines up-to-date—US-44d, August, 12.
The progress of the submarine—E-2, August 10, 12.
The transporter ship *Kanguroo* for submersible boats—E-5, July 19, 12.
An auxiliary for submarine service—E-4, September 27, 12.
The influence of coast fortresses on naval strategy—E-8, September, 12.
Our first Diesel-engine submarines—US-23a, July-August, 12.
To make the submarine safer—US-44d, November, 12.
The safety of submarines—F-12, September 14, 12.
The stability of the submarine during submergence—G-5, August, 12.
Submarines in the defense of sea-fortresses—A-1, No. 7, 12.
The value of our submarine flotillas. Lessons of the summer maneuvers—F-12, October 5, 12.

Torpedo-Boats:

Torpedoboats and destroyers—F-2, May, 12.
The torpedoboat destroyer: what it is and what it should be in the light of the Russo-Japanese War—F-10, May, 12.
Torpedo craft—E-2, August 24, 12.
Greek torpedoboat destroyers *Lion*, *Panther*, *Hawk* and *Eagle*—E-5, November 8, 12.
Suggestions as to the application of torpedo boats—A-1, No. 5, 12.
The torpedoboat destroyer: what it is and what it should be, in the light of the Russian-Japanese war—F-10, June, July, 12.

WARSHIPS

An improvement in floating dry docks—US-40, June, 12.
The design of cruisers—E-4, May 17, 12.
The development of submarine protection—F-10, April, 12.
The gyroscope compass—F-12, May 25, 12.
Marine propulsion—E-5, May 24, 12.
Protection to battleships (armor)—F-12, May 18, 12.
The relative importance of turret and telescopic sight—US-40, June, 12.
The *Selandia*—US-43L, June 22, 12.
Steps necessary for progress in aviation—US-31, June, 12.
The strength of large ships—US-43L, June 1, 12.
The swing of the pendulum. (As to the 6-inch naval gun)—E-4, June 28, 12.
Theory and operation of the gyroscope and the Sperry gyroscopic compass—US-40, June, 12.
Boilers and engines (naval)—F-12, June 22, 12.
The change of merchantmen into men-of-war on the high seas in time of war—F-10, May, 12.

Comparative strength of the chief naval powers—US-15, August 1, 12.
The dreadnoughts of the principal navies and the evolution of the battleship —F-12, August 31, 12.
Electric propulsion of ships—E-3a, August 30, 12.
Electrical equipment for the propulsion of the U. S. Collier *Jupiter*—US-16a, August, 12; E-3a, August 30, 12; E-5, August 23, 12.
General tendencies in (naval) construction abroad—F-10, May, 12.
Military use of pre-Dreadnoughts—F-12, September 7, 12.
A new form of underwater attack—US-42, August 3, 12.
Recent advances in the art of battleship design—E-11, July 19, 12; US-20, August, 12.
Replenishment of fuel oil—F-12, August 24, 12.
The turbine and battleships—E-4, August 23, 12.
Warship names—E-2, September 7, 12.
Arming ships of war—G-1, May, 12.
The battleship of the future—*Invulnerable*—A-1, No. 11, 12.
Care of modern powders on board ships—M-5, May, 12.
Causes of accidents on board warships during peace—G-5, November, 12.
Changes in construction of warships in recent years—G-5, September, 12.
Continental armored construction—E-2, September 28, 12.
Determination of tactical diameter and turning radius of ships—M-5, March, 12.
The jubilee of the turret ship—US-23a, July-August, 12.
Management of modern warships—Sp-3, April, May, June, July, August, September, 12.
Primary armament and protection of battleships below the waterline—G-5, May, 12; A-1, No. 7, 12.
Protection of warships against torpedoes, mines and subterranean missiles—A-1, No. 5, 12.
Some military principles which bear on warship design—E-18, 12; G-5, June, 12.
Turning circles—E-18, 12.
Turbine and battleships—A-1, No. 11, 12.
Use of fuels in the United States navy—US-43L, September 29, 12.
England:
The battle-cruiser—master of the sea—US-13, July, 12.
Fuel for warships—E-19, July 25, 12.
Torpedo craft—E-2, August 24, 12.
H.M. battle-cruiser *Princess Royal*—E-5, September 20, 12.
H.M. Australian cruiser *Melbourne*—US-23a, July-August, 12.
The launch of H.M.S. *Audacious*—E-5, September 20, 12.
Germany:
The French reply to the German armaments—an open memoir to the minister of war—F-0, May 25, 12.
The German battle-cruiser *Moltke*—US-42, June 22, 12.
Comparison of the *Helgoland* type and the *Kaiser* type—F-10, May, 12.
The German ships of the *Kaiser* class (new)—F-12, July 27, 12.
The German Battleship *Westfalen*—F-12, June 29, 12.
The Imperial German cruiser *Goeben*—E-4, September 6, 12.
The battleships of the new *Kaiser* class—US-23a, July-August, 12.
France:
Cooling ammunition quarters on French battleships—US-43L, June 8, 12.
The battleships of 1913—F-12, September 7, 12.

French destroyer *Dague* on trial—E-4, August 16, 12.

French warship building—US-4, August 17, 12.

The *Kangaroo*, vessel for transporting submarines—F-1, July 27, 12.

The dreadnoughts of the French navy: the battleship *Paris*—F-1, October 5, 1

The French naval concentration in the Mediterranean—F-12, September 21, 12.

Italy:

The Italian cruisers of the *Conte di Cavour* type—F-12, June 1, 12.

The navy in the Italian-Turkish war—F-12, October 26, 12.

The Italian squadron in the Dardanelles—M-5, June, 12.

Japan:

The Japanese battle-cruiser *Kongo*—E-4, May 24, 12; E-5, May 17, 12; A-1, No. 7, 12.

The Japanese battleship *Kawachi*—E-5, July 26, 12; F-12, June 6, 12.

Minor States:

The navies of the belligerent powers in the Balkan war—F-12, October 26, 12.

Reorganization of the Portuguese fleet—P-1, April, 12.

United States:

Our latest battleships, the *Nevada* and *Oklahoma*—US-23a, May-June, 12.

The new dry dock at the Brooklyn navy yard—US-4, May 18, 12.

The original contract for the *Monitor*—US-20, May, 12.

The three-gun turrets of the new battleships—US-23a, May-June, 12.

U. S. S. *Florida*. Description and official trials—US-20, May, 12.

United States battleship *Florida* (Illustration)—US-23a, May-June, 12.

The American super-dreadnoughts, *New York* and *Texas*, *Nevada* and *Oklahoma*—F-12, August 10, 12.

A battleship with cruiser speed—US-42, August 17, 12.

The commission on oil engines for the navy—E-4, July 26, 12.

Electric propulsion of the United States collier *Jupiter*—E-5, August 23, 12; E-3a, August 30, 12; US-15, September 12, 12.

The equipment of a new American battleship—E-11, August 16, 12.

The latest American battleships, *Nevada* and *Oklahoma*—F-10, May, 12.

The *Nevada* and *Oklahoma*—E-11, July 19, 12.

United States battleship *Florida*—US-13, August, 12.

U. S. S. *Beale*, description and trial performance—US-20, August, 12.

U. S. S. *Jouett* and *Jenkins* contract trials performance—US-20, August, 12.

U. S. S. *Wyoming*, description and official trial—US-20, August, 12.

The imposing naval review at New York—US-42, October 12, 12.

MICELLANEOUS

An Anglo-French alliance—F-0, May 29, 12.

The Bagdad railway and why it is of interest to the United States—US-40, June, 12.

Coordination before and during war—US-40, June, 12.

The heavens in June—US-42, June 1, 12.

The loss of the *Titanic*—E-8, May, 12.

Millerand's laws of the air—I-0c, March 31, 12.

The Panama Canal. Probable tonnage and revenue. Economic consequences—F-1, June 8, 12.

The philosophy of war—US-16b, May-June, 12.

Testing of thermometers—US-6a, Cir. No. 8.

The army horse—US-24, September, 12.
The new cavalry equipment—US-24, September, 12.
Our National Flag. A short history of its development. Its lack of uniformity in Government displays. Sentiment or sentimentality in its use—US-40, September, 12.
Saber *vs.* pistol, a solution—US-24, September, 12.
The apprenticeship of war—F-1b, June 15, July 1, 15, Aug. 1, 15, Sept. 1, 12.
The Coast Artillery Reserves—US-2, August 29, 12.
Electrical equipment for the propulsion of the U. S. Collier *Jupiter*—US-16a, August, 12.
The evolution of war—F-1b, August 15, September 1, 15, October 15, 12.
Fire discipline—E-3d, July, 12.
Infantry officers at Saumur—US-24, July, 12.
The land-side defense of defended ports—E-3d, August, 12.
The Lewis automatic gun—US-16b, July-August, 12.
Marching to the sound of guns—E-9, July, 12.
The new German Fleet Law—and General Von Bernhardi—E-20, Sept., 12.
Notes on the morale of the Japanese army—E-9, July, 12.
Practical hints on marching and health on active service—E-3d, July, August, 12.
Scientific foot treament for the army—US-43L, August 17, 12.
The Sperry gyroscopic compass—I-3, June, 12.
A study on discipline—F-1b, June 15, August 15, September 1, 15, 12.
The tactical employment of the infantry machine gun—US-23, September-October, 12.
Artillery review—S-4, July, 12.
The blessings of war—E-9, October, 12.
Camp sanitation—US-15, October 17, 12.
The color of the uniform—F-1b, October 15, 12.
Concerning preparation for war—F-1b, October 15, 12.
Contribution on the theory of recoil guns—G-1, July-August, 12.
Disposal of garbage in barracks—US-29, October, 12.
Demolition of wire entanglements—US-23, November-December, 12.
The development of the art of defense—S-1, June 8, 12.
Democracy and military discipline—P-4, May, 12.
Does the moderate use of alcohol lower health and efficiency, and should it be prohibited among officers and officials of the military, naval and civil services—US-23, November-December, 12.
The dread of incurring losses on the battlefield—US-23, Nov.-Dec., 12.
Effect of field artillery—A-3, October, 12.
Erosion of guns and the influence of temperature on the rifling—A-1, No. 5, 12.
Field engineer troop summer training—E-14, November, 12.
A French opinion of the German officer—Sp-0b, January, 12.
Fortifying the Canal. A legal right and a matter of national expediency—US-42, November 9, 12.
Foundation of the theory of war—S-4, October, 12.
Guns and howitzers for casemates—E-7, October, 12.
Importance and application of searchlights—G-6, May 9, 12.
Infantry and rapid fire cannon—M-2, June 15, 30, 12.
Landsman's log aboard the United States destroyer *Patterson*—US-42, October 5, 12.

The Maxim machine-gun—S-6, July-August, 12.
Means of illumination in war—G-4, No. 6, 12.
Means of transmitting orders on the firing line—G-6, April 20, 12.
Military history and the science of business administration—US-13, October, November, 12.
Mishaps with guns and ammunition during the years 1909-1911—G-1, April, 12.
The modern Indian officer—E-9, October, 12.
The navy personnel bill—US-31, November, 12.
A new Krupp naval cannon—I-3, July-August, 12; G-I, June, 12.
The new large-caliber mortars—S-6, July-August, 12.
The North-Eastern frontier—Assam—E-2c, October, 12.
The north Irish horse—E-2c, October, 12.
Novel devices used in the launching of the battleship *New York*—US-15, November 14, 12.
Obligatory military service—M-2b, June, 12.
On the influence of depth of water upon the resistance of ships—F-10, July, 12.
On the psychology of exercise and drills—S-1, June 22, 12.
Peace as a political problem—G-9, August, 12.
Plea for the bull's-eye—US-16b, September-October, 12.
Policing a battle field. Field sanitation—S-6, July-August, 12.
Practical determination of the magnifying power of telescopes—US-40a, November-December, 12.
Prisoner of war—S-3, June, 12.
Projectile hoist for artillery of medium caliber mounted in protected pits—I-2, July-August, 12.
Psychology of a commander-in-chief—M-0, April, May, June, July, 12.
Remarks on the training of Belgian youths for military service—S-6, July-August, 12.
The salvage of the Italian armored cruiser *San Giorgio*—A-1, No. 5, 12.
Shallow battle trenches—I-2, June, 12.
Simplicity and complexity in our elementary training for war—E-2c, Oct., 12.
A soldier colony—US-24, November, 12.
The soldier's dietary—E-19, October 10, 12.
Soldiers and sleep—E-20, October, 12.
Strategical position of Great Britain in a maritime war: (1) if Ireland were neutral; (2) if Ireland were hostile—E-20, November, 12.
The suction produced by ships, etc.—M-4, April, 12.
Synchronization of clocks and the importance of correct time—E-14, Oct., 12.
The training of a yeomanry officer—E-20, October, 12.
Traveling kitchens—US-23, November-December, 12.
Types and traditions of the old army—US-23, November-December, 12.
The United States army in the riding competitions of the Olympic games, Stockholm, Sweden, 1912—US-24, November, 12.
The ultimate dimensions of the largest seagoing vessels—US-21, Nov., 12.
Various optical instruments—G-4, No. 9, 12.
War in the desert—I-2, July-August, 12.
Weather in war—E-9, October, 12.
Winning the 1912 Palma—US-2, September 19, 12.
A word on the offensive and long-range fire—S-6, July-August, 12.

Eng. Lib.
GENERAL
DEC 18 19
UNIV. OF MICH

CUMULATED SEMI-ANNUALLY

Index to Current Military Literature

PUBLISHED WITH THE

Journal U. S. Artillery

VOLUME 38
JULY TO DECEMBER, 1912
CUMULATED

Fort Monroe, Virginia
COAST ARTILLERY SCHOOL PRESS
1912